MODEL HOOKUP NUMBER

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This three-dimensional handbook, based throughout on actual models, is the work of many men. All models were constructed by POWER'S *editorial staff, assisted by William Vopat. Photographs were made in the McGraw-Hill photographic laboratory. Retouching by McGraw-Hill Illustration Dept. Aquatone printing by Edward Stern & Co, Philadelphia, Pa.*

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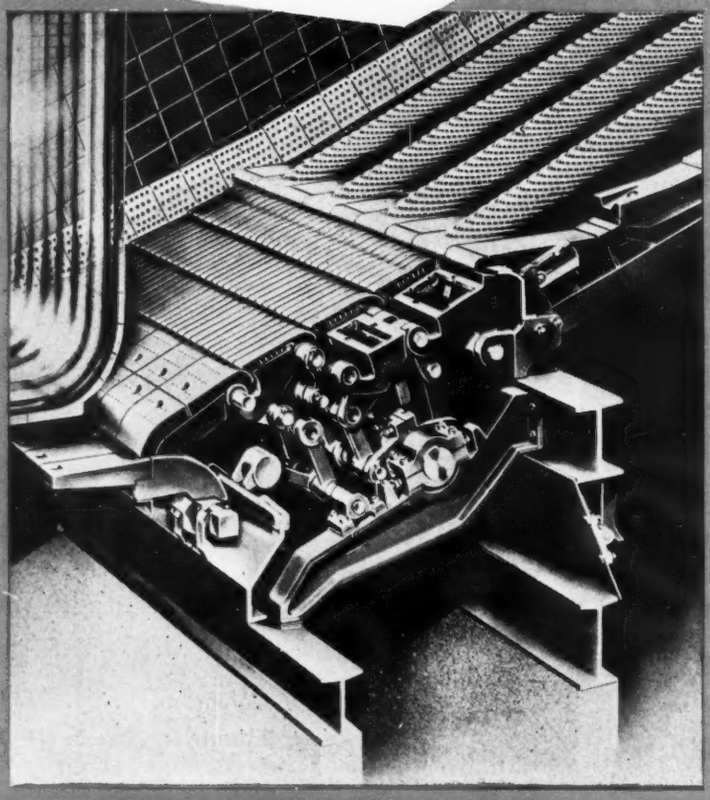

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HANDBOOK *of* HOOKUPS

WHEN COLUMBUS proved the world a sphere, man began to live and think in the round. But the limited vision which once made him see the world as flat now hampers him again, for his engineering works have grown to exceed his eye's compass.

True, he makes flat drawings showing infinite detail, but these he must translate into mental models before he can grasp them. He may go even further; some modern bridges and power plants are first built in miniature to give their builders a clear picture of part location. Images of these solids "stay put" in the mind's eye, lining themselves up like soldiers for inspection.

Eight years ago, POWER's first Hookup Number, meeting a vital need, drew the greatest spontaneous reader approval. But power progress never ceases, and the editors faced the responsibility of modernizing the Hookup Number. Could hookups be shown as models in three dimensions?

It took a year of work, but results have surpassed our hopes. Here, for the first time in publishing history, is a parade of power hookups in three dimensions, a practical presentation literally carved from the solid. Like the X-ray, which penetrates nerve and muscles to trace hidden outlines of the human skeleton, these photographs of models pierce mortar, stone and steel to reveal the inner nature of power plants.

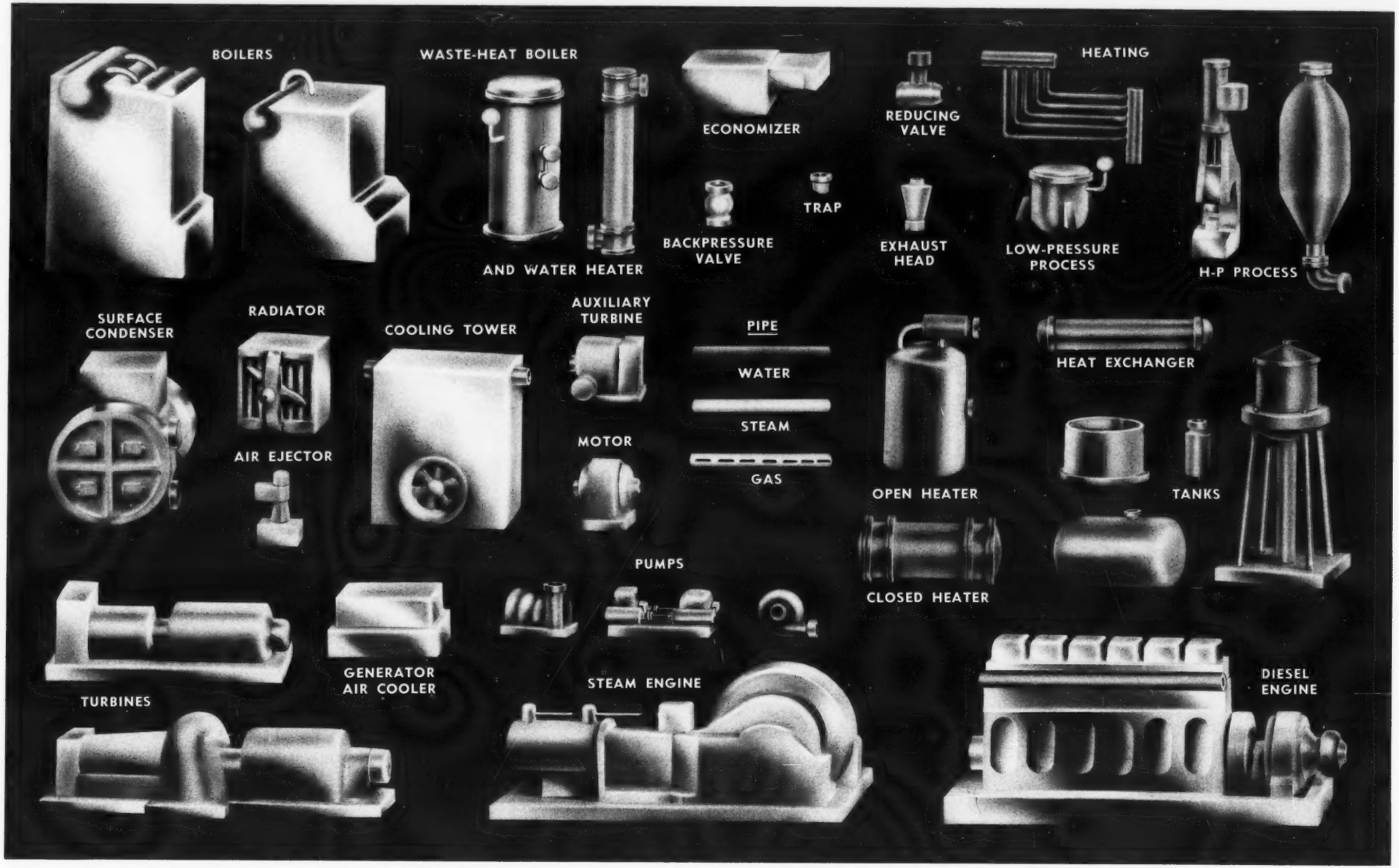
They are arranged in three categories. "Evolution" shows, in a series of simple steps, how and why today's power patterns have been developed. "Elements" makes real the various possible arrangements of plant functions — feed heating, feed treating, evaporating, desuperheating, and so on. "Applications" combines the elements into actual modern plants, chosen to give the widest possible variety in equipment, hookups and principles. Institutional, industrial and utility, diesel and steam, large and small, simple and complex, these typical working plants march before you.

"To see things is to know them." Here is an opportunity to *see* power plants in a space that the eye and mind can compass. Economical plant design must follow the natural order of design analysis: "Compare, Select, Perfect." Compare hookups, test possibilities, adopt profitable suggestions, and make your own design to suit your own problem, feeling certain that you have overlooked no real opportunity for economy.

To operating and consulting engineers, these photographs provide a practical handbook of present-day hookups in a convenient, ready-reference form. Any power problem can be intelligently discussed, with manager, engineer and operator in perfect understanding, for equipment and arrangements both take substance before them — a sound starting point. For the junior, tomorrow's chief, it provides the fundamentals.

To power men everywhere, the editors offer this Model Hookup Number as a contribution to clear thinking, sound design, and the saving of power dollars.

PHILIP W. SWAIN, *Editor*



KEY TO MODELS INCLUDED IN EVOLUTION SECTION, PAGES 60 TO 71

EVOLUTION

INVENT a wheel. Invent a sail. Put sails on the wheel to make a windmill. Plunge the windmill in a swiftly flowing stream to make a waterwheel. Reverse the waterwheel to make a propeller or centrifugal pump. Move the propeller back into the air to make a fan.

There's a fair sample of the evolution of a mechanical idea. Actual development of machines was much that way. Certainly every modern engineer who would be worth his salt must learn to think that way, moving step by step from the simple to the complex. No man really understands a centrifugal pump until he understands sails and wheels. No engineer is a master of actual plant hookups until he can "roll his own", starting from scratch.

So it was in the history of power development. First steam plants had boilers operating at little more than atmospheric pressure, Newcomen engines, and little else. Watt added the separate condenser and started the long string of improvements made by increasingly Btu-minded generations of power engineers.

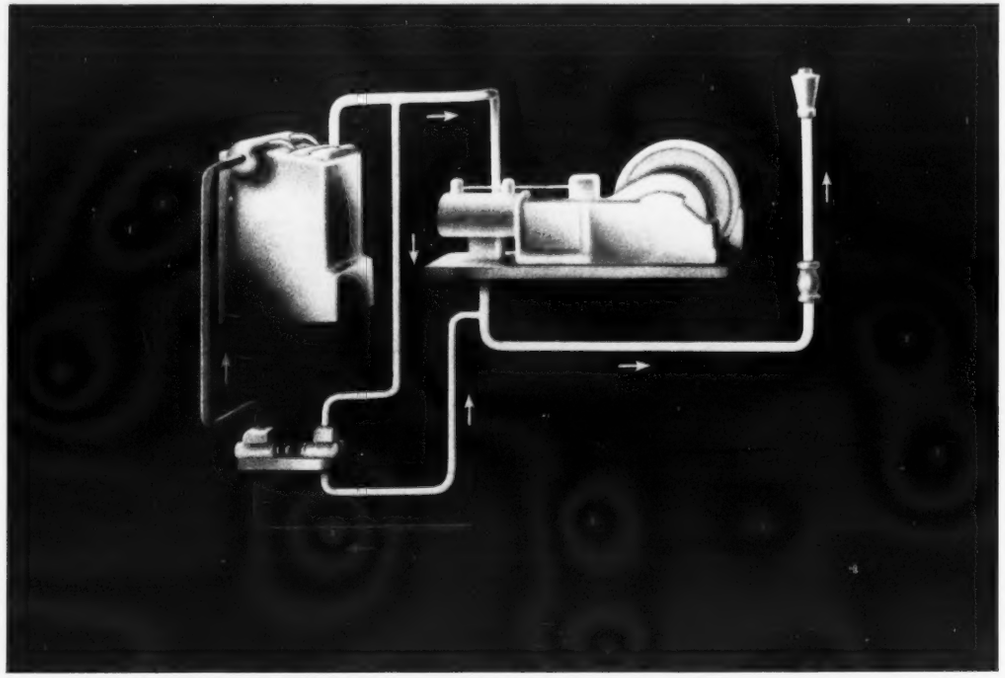
That's history, but if we put history completely out of mind, and merely set out to improve the simplest plant by logical steps, we find ourselves automatically retracing 200 years of power pioneering and thereby grasping the true meaning of today's engineering job.

That's exactly what has been done in this section — "Evolution". Starting from scratch with minimum plant — boiler, prime mover, and feed pump — successive hookups show how economy is improved and operating difficulties are eliminated by adding feedwater heating, by condensing, by bleeding the turbine, etc. So, step by step, the series works up from plants that just run to plants that pay dividends.

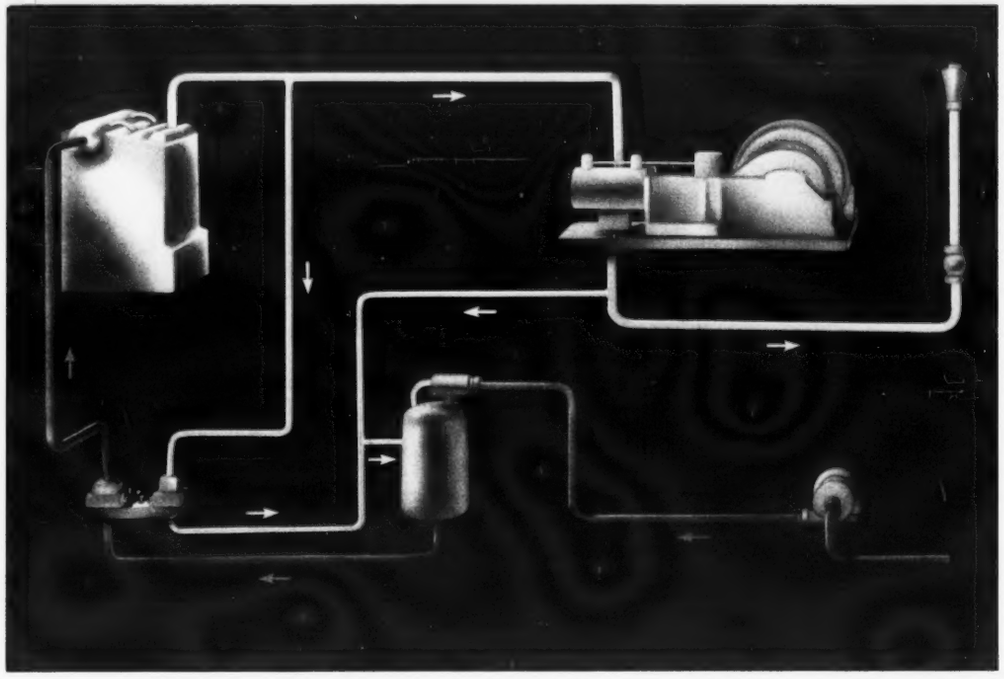
Three evolutions are shown: Power, Process and Diesel. The first develops a steam plant for power primarily. The second shows what happens when process steam is required, with or without power. Quite different, diesel arrangements naturally fall in a separate third group.

As a starter, let's roll up our sleeves and take a look at the equipment models on the facing page. They're the kit — the set of building blocks with which the whole job must be done. Each model conveys the idea of a function, not a specific piece of equipment. The digester, for example, represents *any* high-pressure process, the cooker *any* low-pressure process. In the hookups that follow, white piping is steam, grey is water, heavy lines are main flow, thinner ones secondary. All have been reduced to extreme simplicity, no valves or bypasses, a minimum of confusing detail.

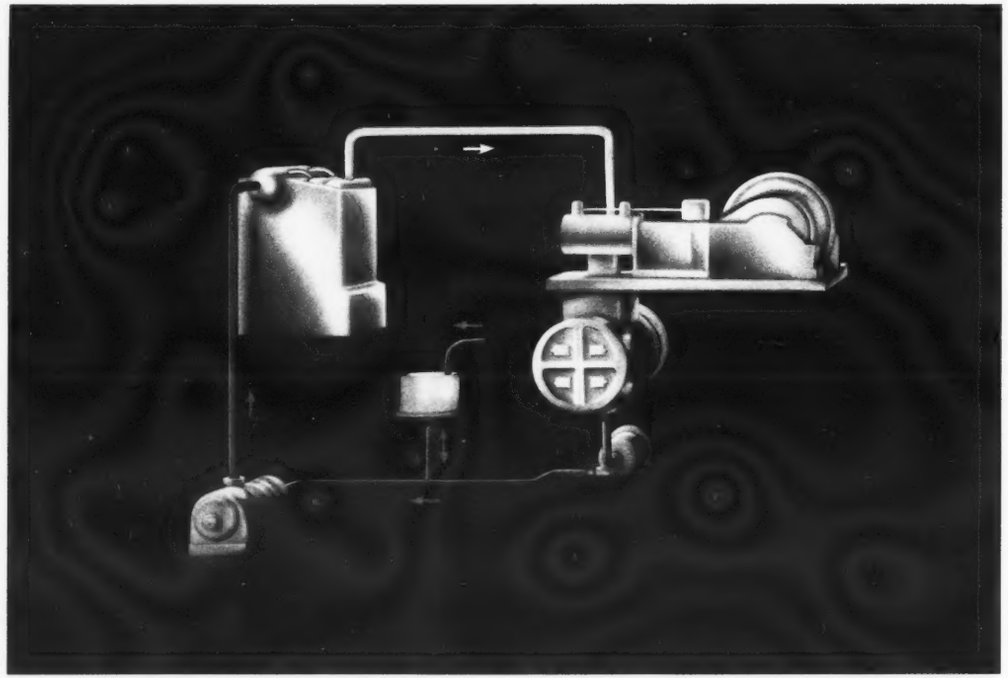
Checking every hookup in this Evolution section takes no more than half an hour. The job is well worth while as foundation building for the practical applications that follow.



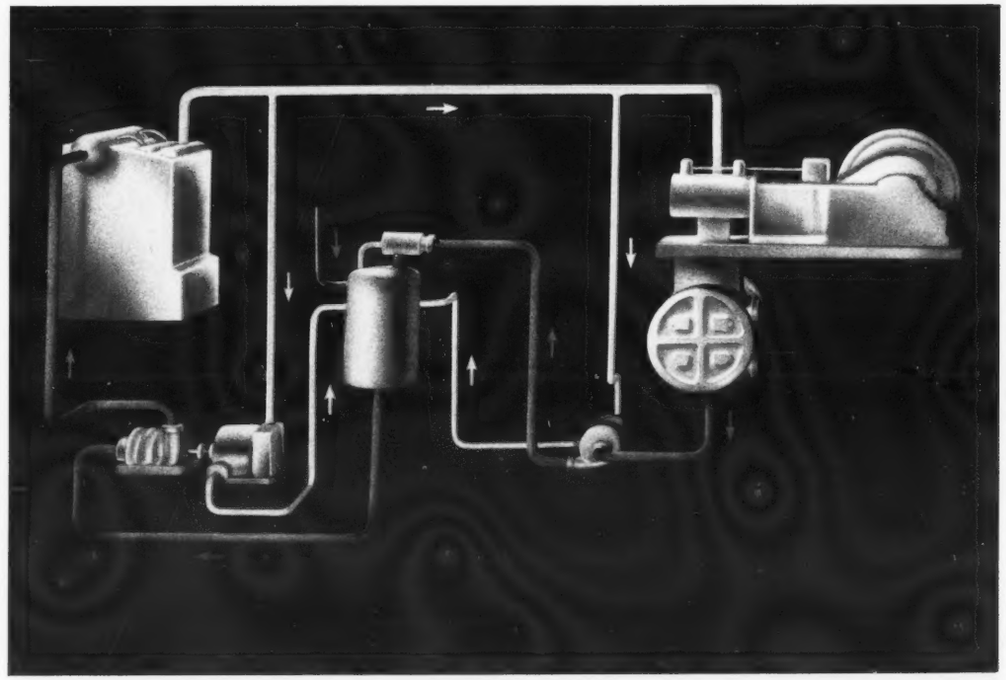
POWER 1 The simplest steam power plant has a boiler to generate steam, an engine or turbine to convert heat energy into power and an injector or feed pump to supply water to the boiler. Steam or electric power must be taken for boiler feeding. Exhaust steam wastes to atmosphere; efficiency is poor and 100% makeup is required, running up water and treatment costs.



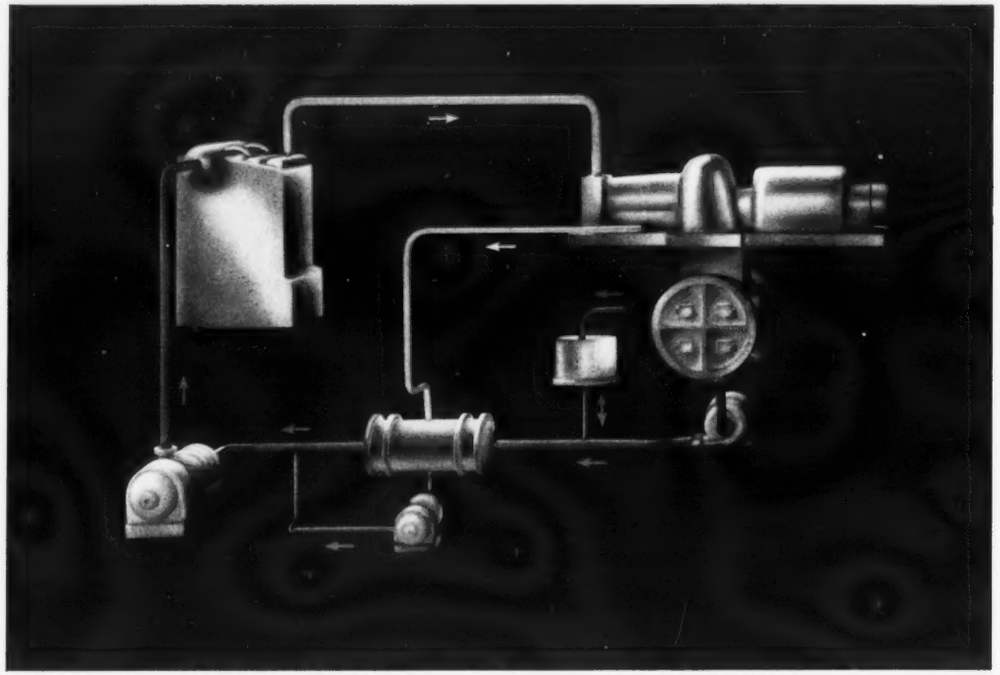
POWER 2 Heating feedwater with exhaust steam from main engine, feed-pump drive, or both, regains heat that would otherwise be wasted to atmosphere. Each 10-F increase improves fuel economy about 1%. Open heater deaerates feed, but water temperature is limited to 215 F. Hookups 1 and 2 fit where low first cost and simplicity come before operating economy.



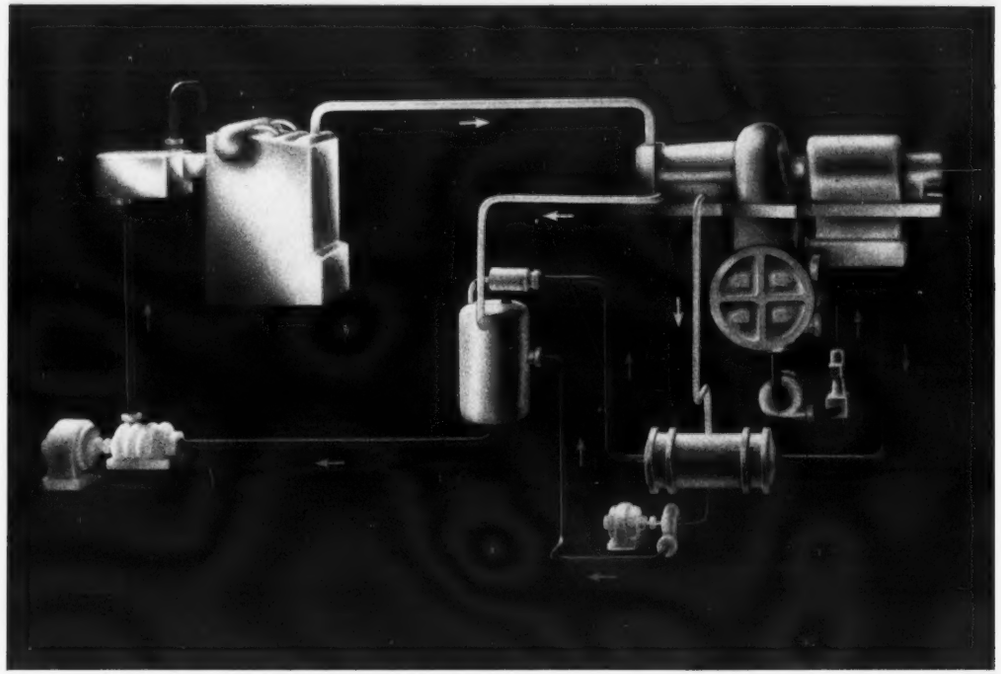
POWER 3 Adding a condenser decreases steam consumption of engine or turbine about 25-50%, and reduces makeup needs to 2-5% of steam flow. A supply of cooling water is essential. Motor-driven auxiliaries are shown; they make for simplicity and are efficient, but need outside power source for starting up. Surge tank smoothes variations in condensate volume, receives makeup.



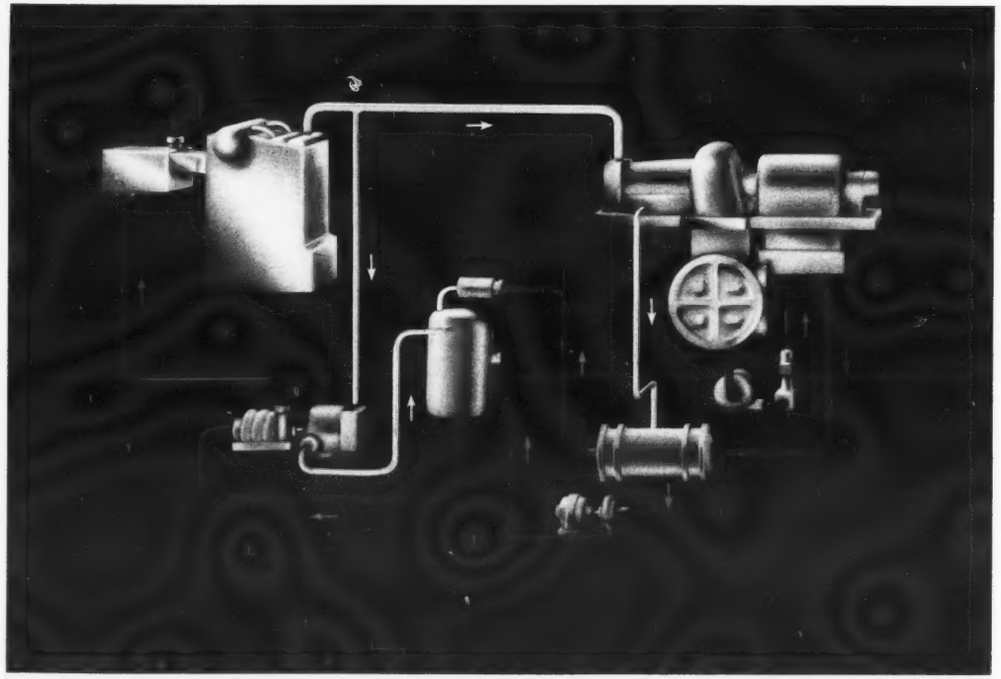
POWER 4 In this hookup, steam-driven auxiliaries have been substituted for motor-driven, and their exhaust heats feedwater. This recovery of waste heat overbalances high steam consumption of small steam driving units, producing a thermally efficient arrangement independent of outside power supply. Makeup can be added at heater or condenser hotwell.



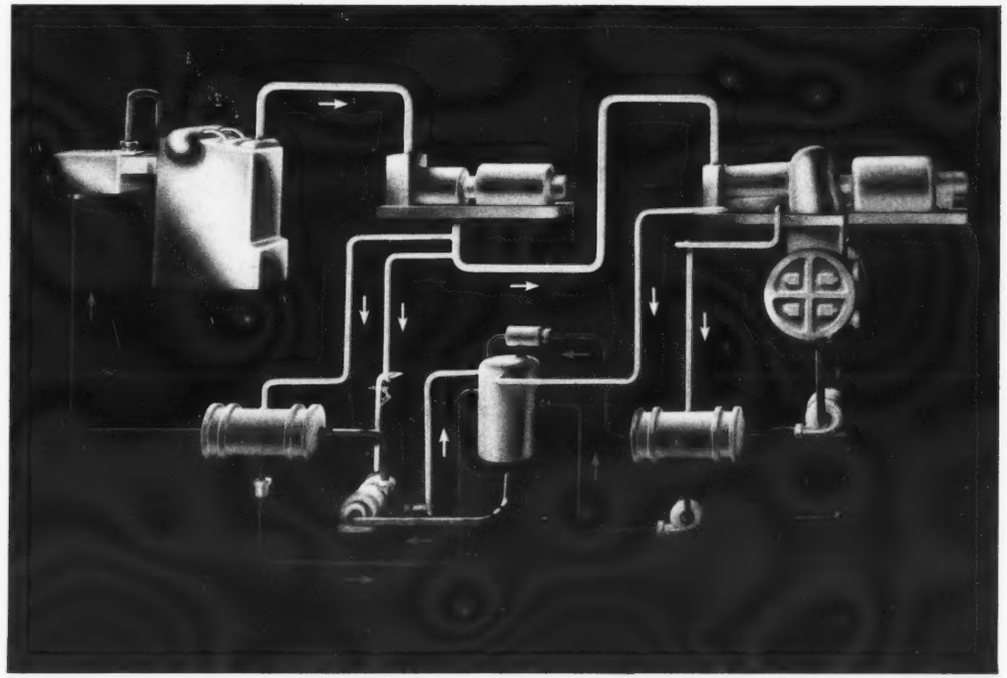
POWER 5 Biggest loss in a condensing power plant is heat given to condenser cooling water. Bleeding steam from prime mover to raise feed temperature improves over-all economy, since practically all heat in bled steam is recovered. Closed heaters can take steam at pressures above atmospheric, which permits heating feed to temperatures above 215-F limit on open heaters



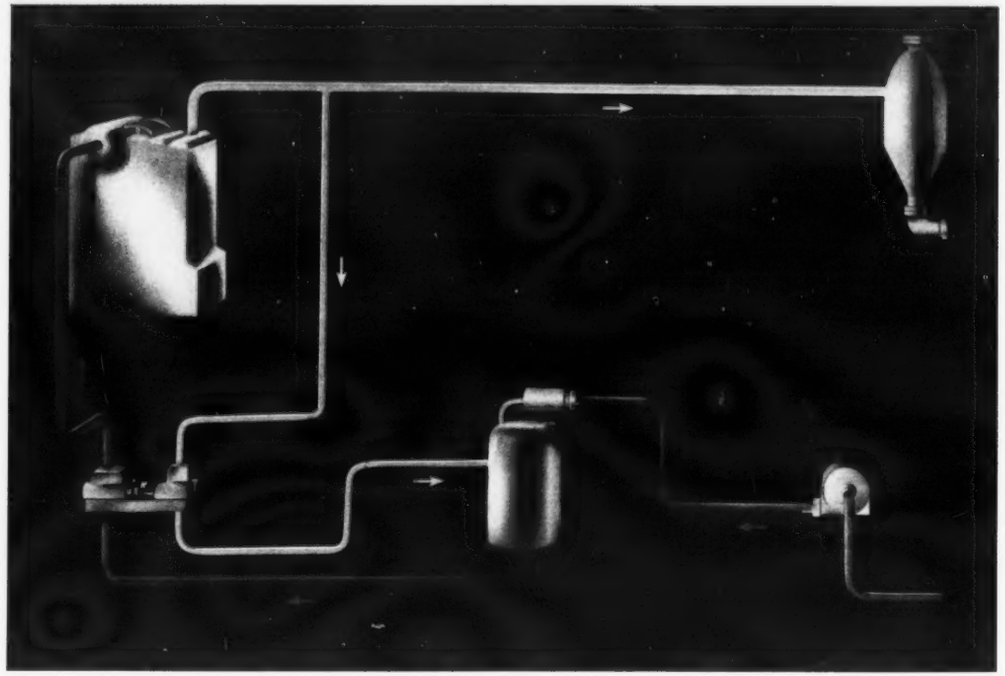
POWER 6 Multi-stage heating produces high feed temperatures more efficiently. Steam from lower bleed point handles low-temperature heating and a small quantity of valuable high-pressure steam brings feed to final temperature. This must be held below point at which water will flash to steam in supply line. Practice usually limits number of stages to four or less.



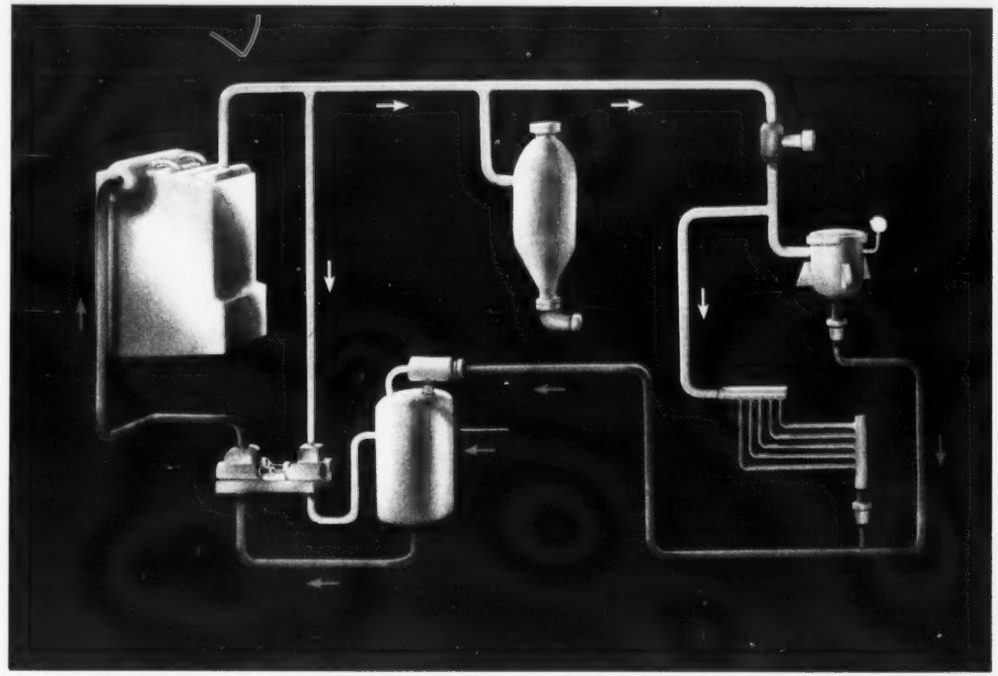
POWER 7 Here exhaust from steam-driven auxiliaries, otherwise wasted, furnishes second-stage heating. Additional heat is recovered in air-ejector condenser and generator air cooler. Economizer reduces flue-gas loss, gaining 4-6% more. This and preceding hookup approach best combination of good fuel efficiency, plant-layout simplicity, moderate first cost.



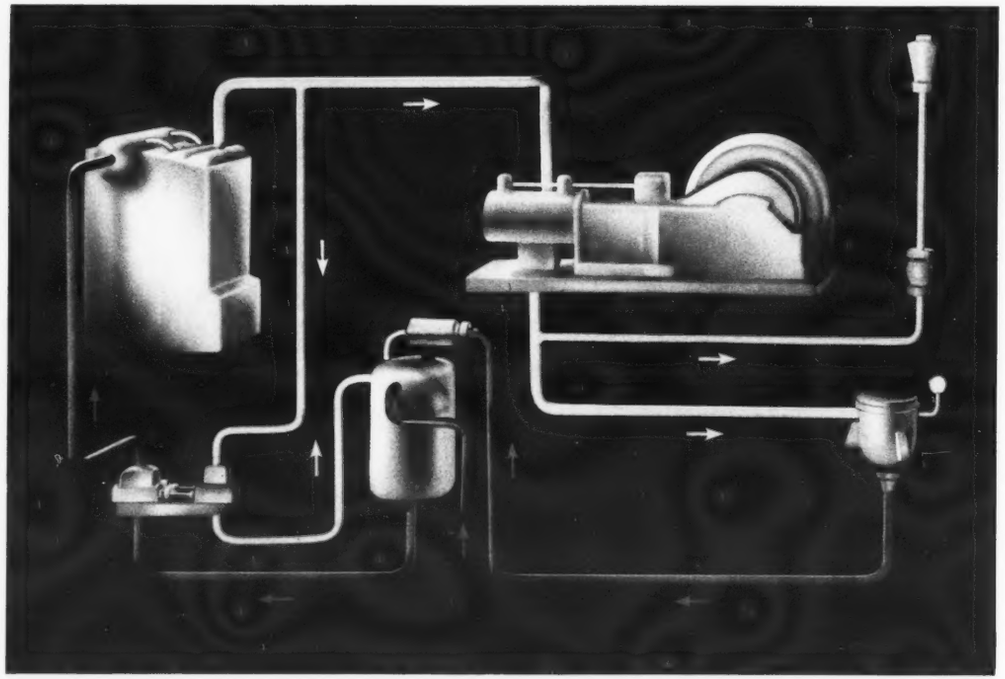
POWER 8 Station efficiency is boosted when initial temperature and pressure are increased. Addition of high-pressure boilers and top turbine exhausting to existing low-pressure turbine will put an old plant on equal footing with a new one, at minimum cost. Crossover heater, taking steam at exhaust pressure of h-p turbine, ties old feed-heating system to new boiler



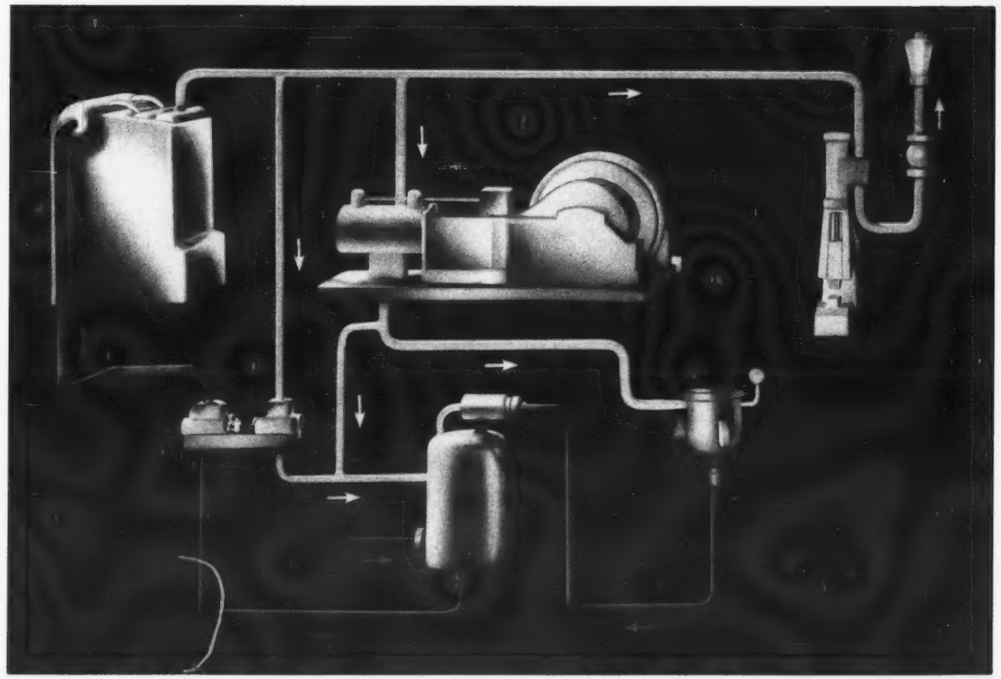
PROCESS 1 Without feed heater this would be simplest hookup for supply of process steam, similar to simplest power plant, POWER 1. As this hookup stands, it represents practical minimum. Process takes steam at boiler pressure and returns no condensate. Open heater raises temperature of 100% makeup with exhaust from feed-pump drive; heater also deaerates feed.



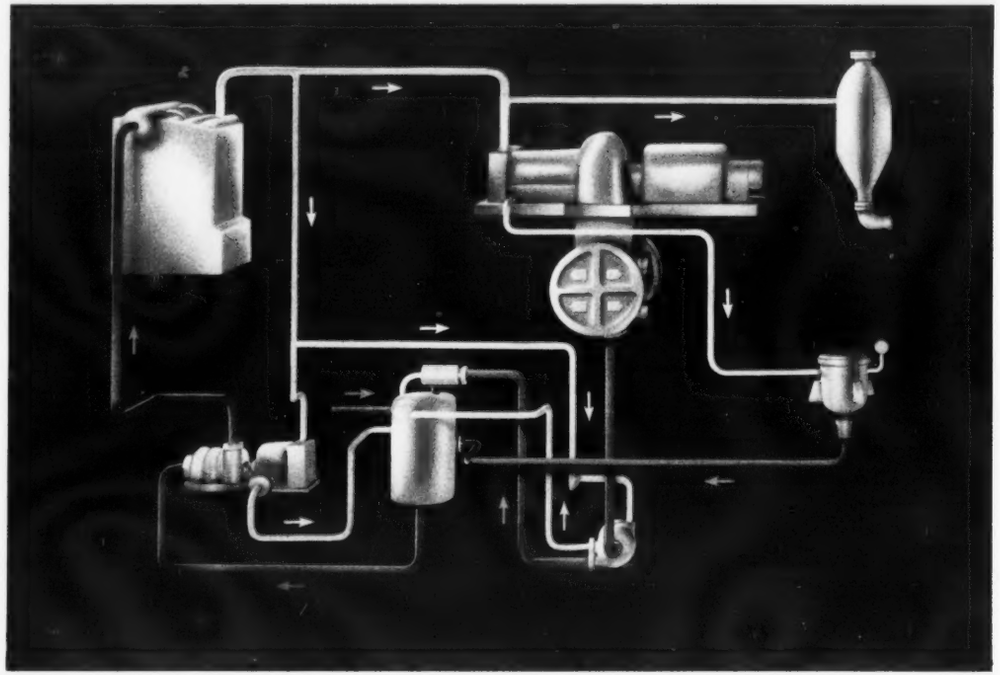
PROCESS 2 Many plants require steam at more than one pressure. Simplest plan involves setting boiler pressure to serve highest process level, securing lower pressures by reducing valves. Condensate from processes may be trapped back to feed system, reducing makeup requirements and returning heat units otherwise wasted. Makeup is added at heater.



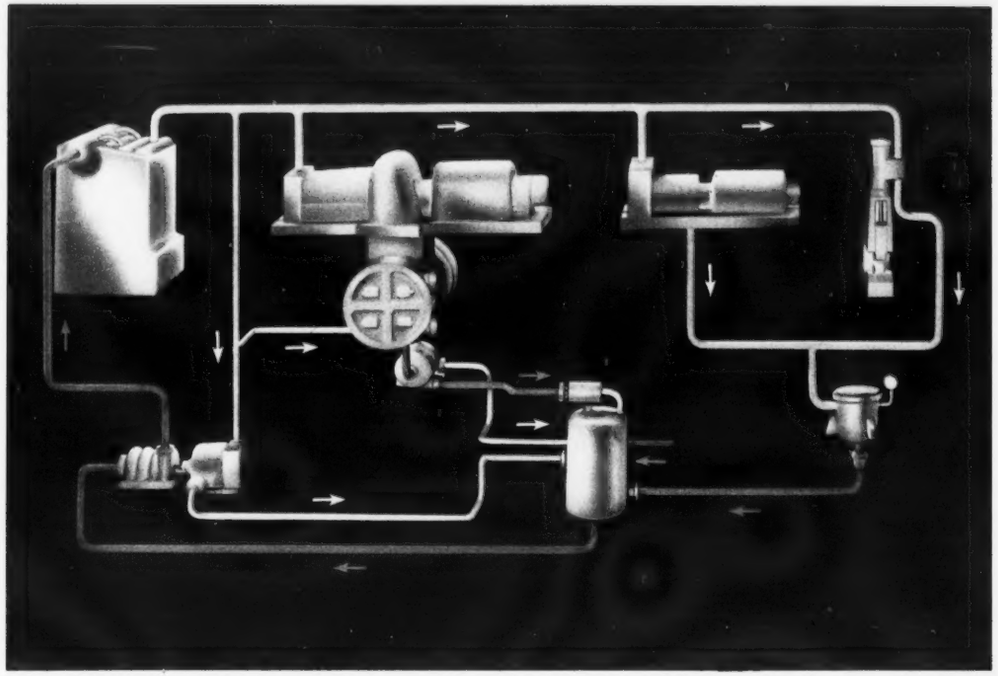
PROCESS 3 If steam must be made for process, it usually pays to increase boiler pressure and expand steam through an engine or turbine exhausting to process. When all exhaust is used, power can be made for 4000-5000 Btu per kwhr. Power cost goes up if lack of balance between power and process-steam loads causes exhaust steam to be wasted to atmosphere.



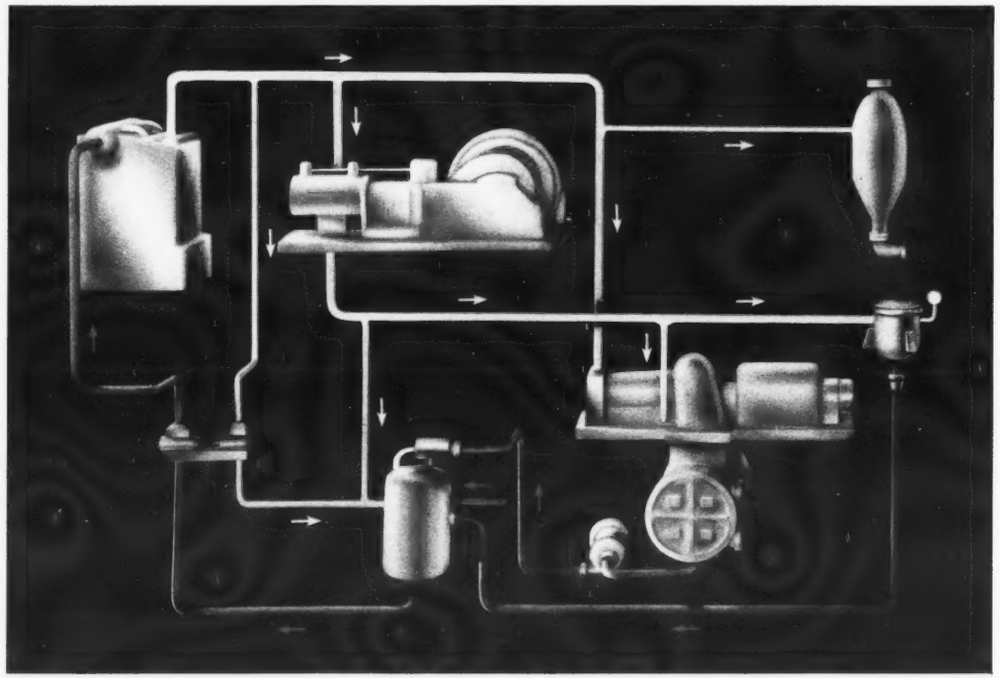
PROCESS 4 Same general hookup may be used where high-pressure process takes steam at boiler pressure. In PROCESS 3, power load exceeds process demand; surplus exhaust is vented to atmosphere. Here, power and process loads nearly balance. Where process load exceeds power, a common case, there should be a reducing valve between main-steam and process headers.



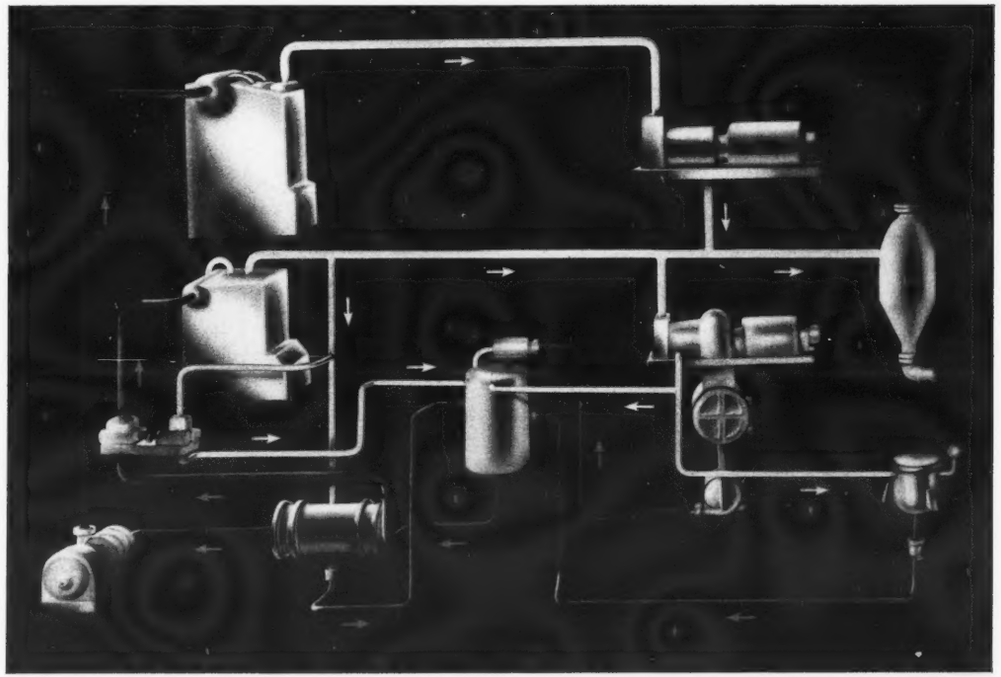
PROCESS 5 Economy of process-power plant depends largely on combining prime movers and auxiliaries to match load. Where power load is high and process low, a condensing turbine makes power most efficiently, and steam that has already been used in turbine can be extracted for l-p process. Auxiliary exhaust heats feed but extracted steam could be used, with motor drives.



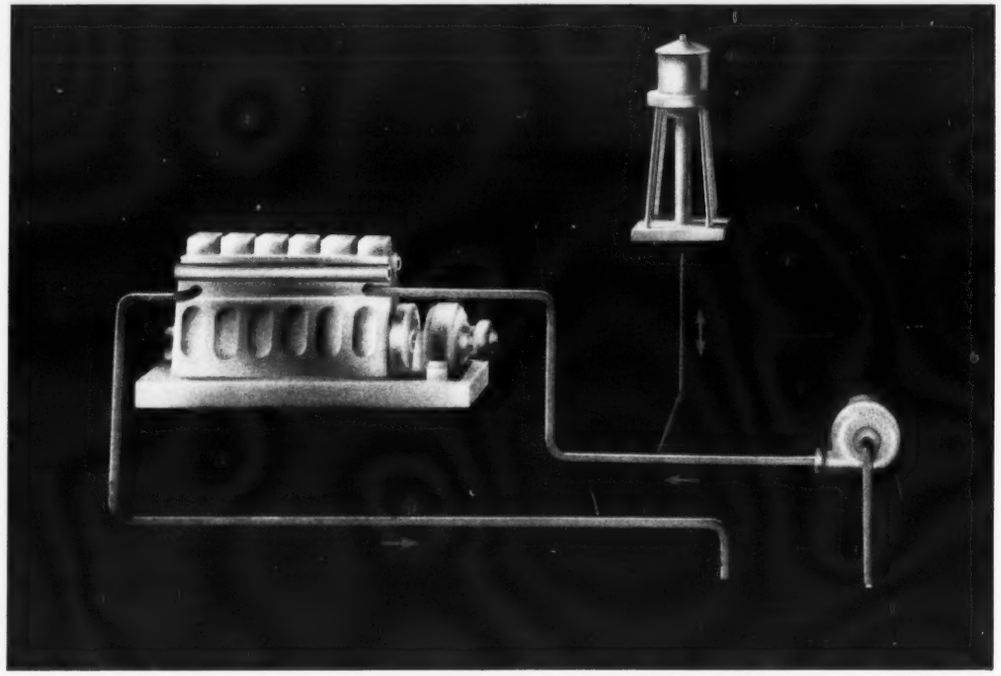
PROCESS 6 Where process and power load are large and not drastically unbalanced, combining a condensing and a back-pressure turbine is effective. Backpressure unit generates as much byproduct power as process demand permits; condensing unit handles remainder of electric load. This hookup also shows recovery of exhaust steam from high-pressure process.



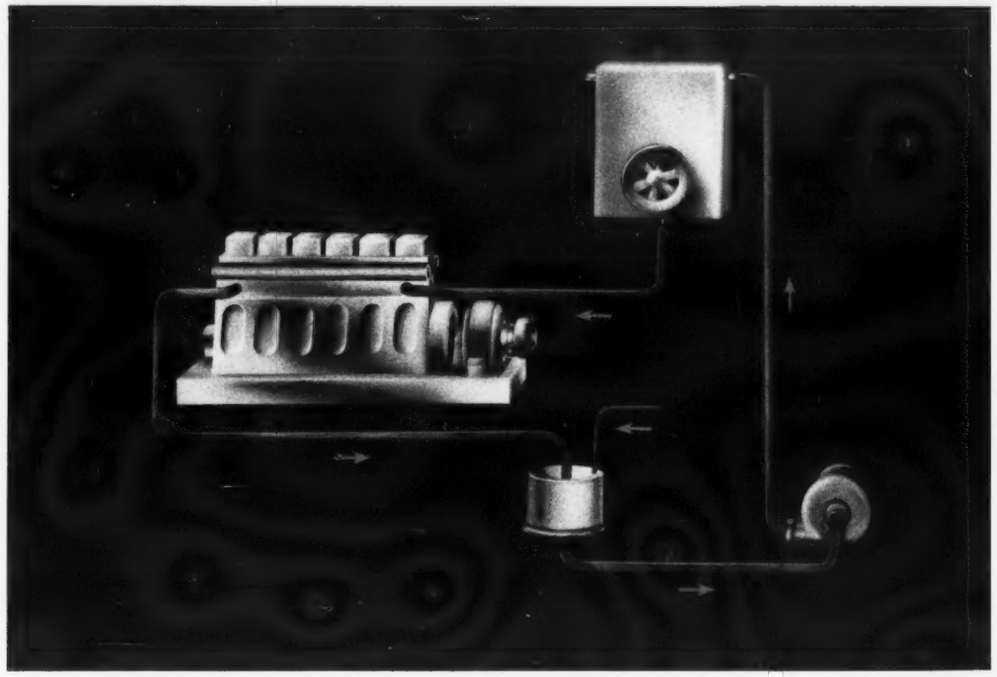
PROCESS 7 Where low-pressure process load is highly variable, a mixed-pressure condensing turbine with a backpressure engine or turbine offers a flexible arrangement. The mixed-pressure unit takes steam at boiler or lower process pressure, or both. Such units suit plants where power load has outgrown process demands and a new prime mover is required for balance.



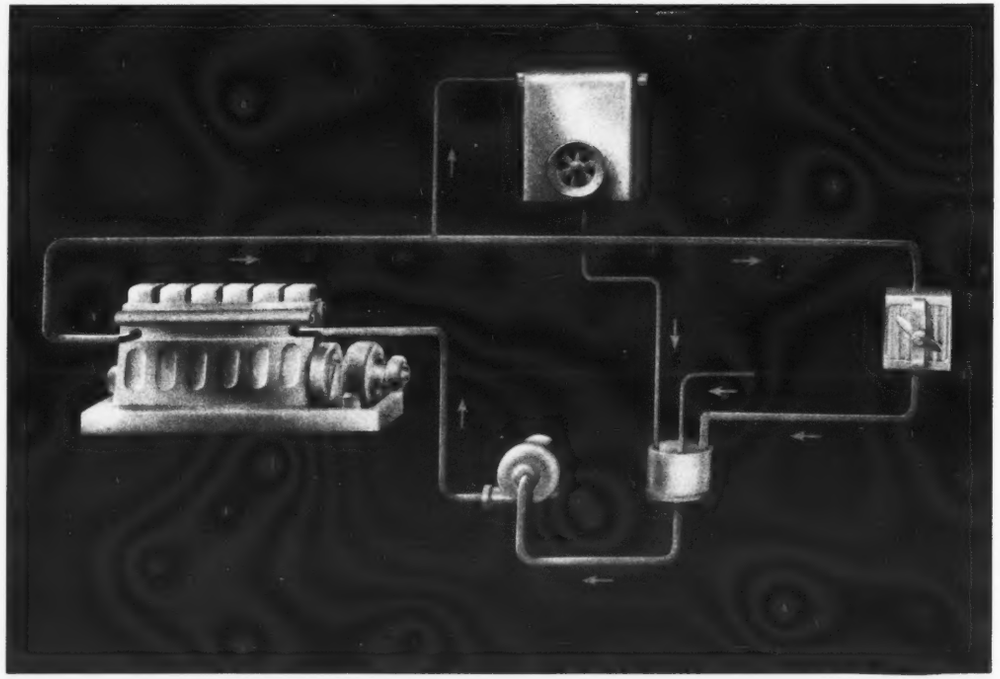
PROCESS 8 Boiler pressure in many industrial plants has been fixed by h-p process requirements. Increased loads can be met and over-all efficiency boosted by adding new high-pressure boilers and a turbine exhausting to former main header. Cross-over heater and new feed pumps complete the change. Old boilers may be operated for peaks or emergencies, or used as accumulators.



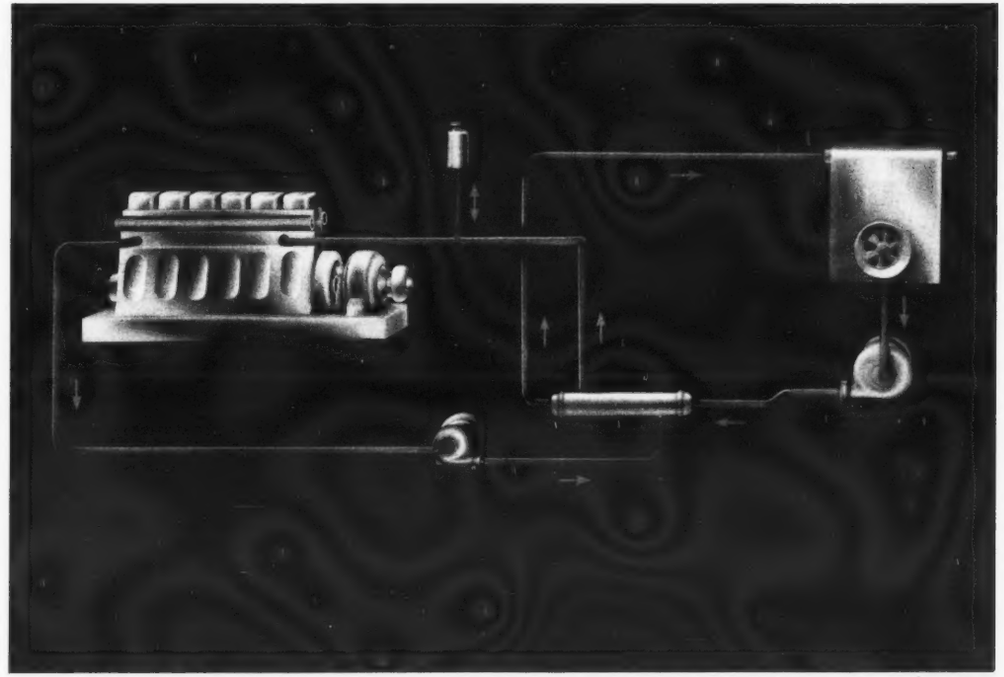
DIESEL 1 Simplest cooling circuit pumps water from river, lake or well directly through engine jackets. Water, with jacket heat, is wasted to original source, or to sewer or diffusing well. Application is limited to areas with plentiful supply of good water and no restrictions on use or disposal. Tower tank may be added to reduce time pump has to run, or for emergency.



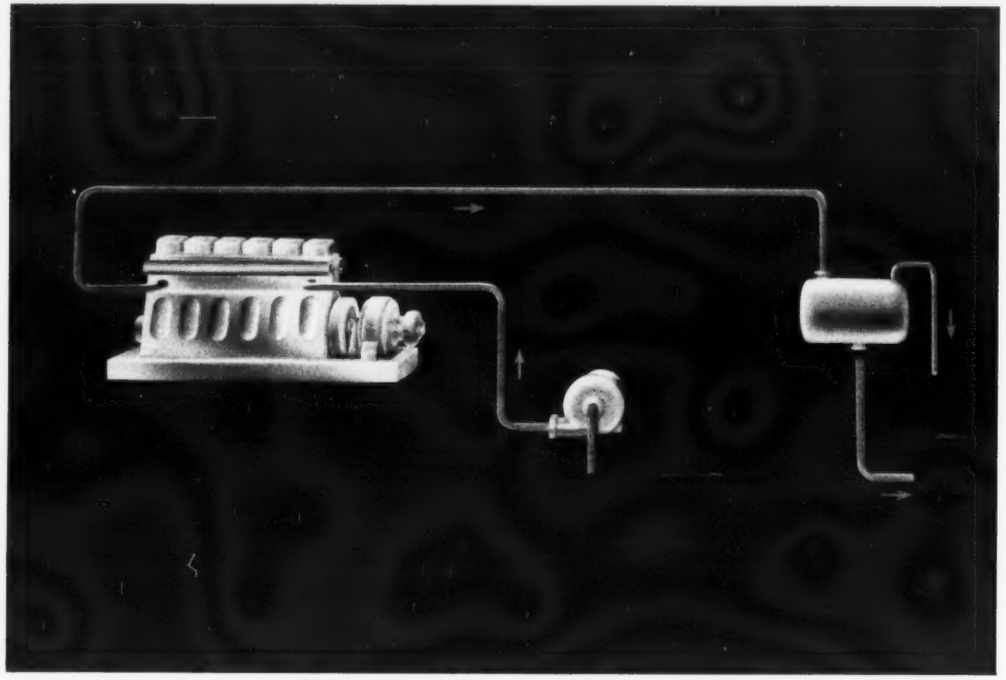
DIESEL 2 Closed-circuit cooling reduces water requirements. Cooling towers, spray ponds, or evaporative condensers reject heat to atmosphere by evaporation, requiring less than 5% makeup. Makeup for ponds and towers should be good quality. Radiators, another means of cooling, reject heat to atmosphere by conduction and require no makeup if kept leak-free.



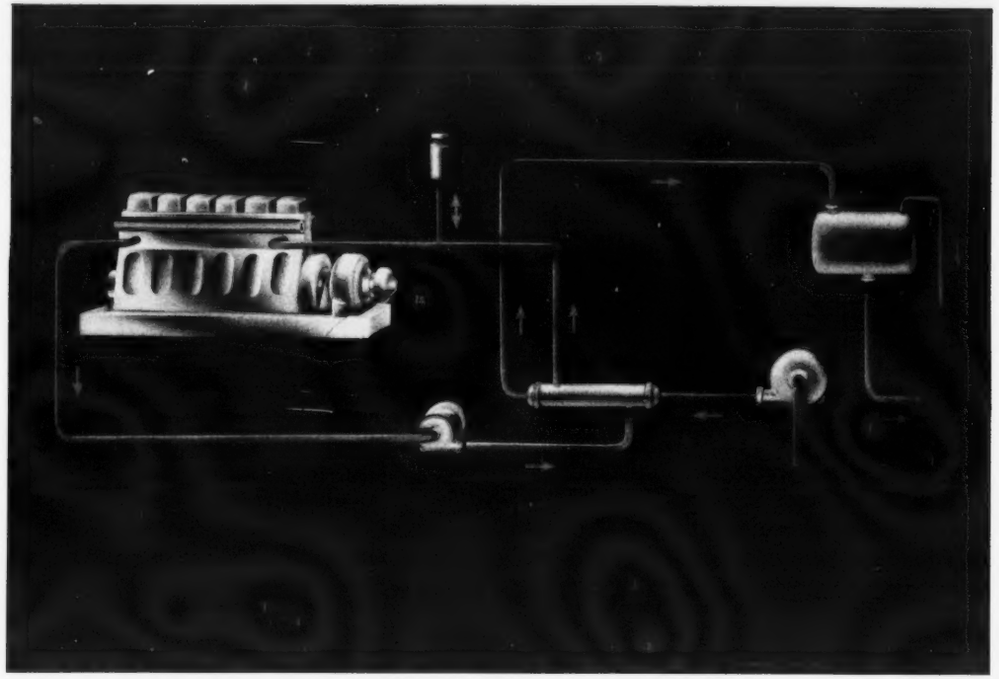
DIESEL 3 Using radiators or unit heaters to heat building space in winter recovers jacket-water heat otherwise wasted. Needed jacket cooling in summer months can be obtained by a cooling tower or equivalent, as shown, or by diverting warm air from radiators to outside of building. Savings from recovery usually outweigh extra investment.



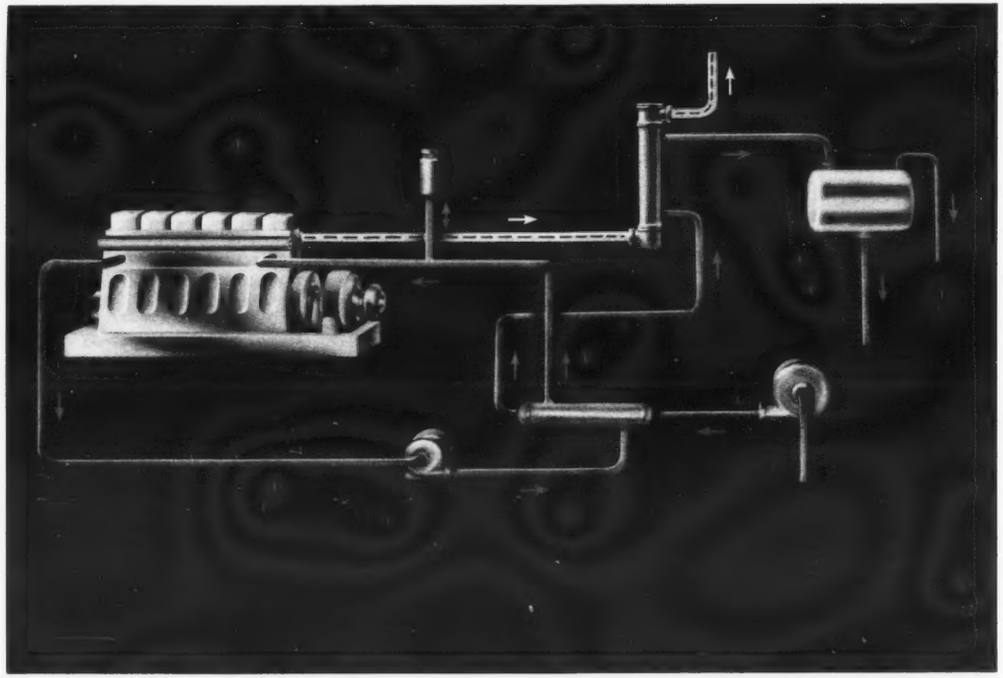
DIESEL 4 Double-circuit cooling circulates pure water in the closed circuit. Heat is rejected to raw water in a heat exchanger, tubes of which can be easily cleaned if scale forms. Evaporative condensers and some cooling towers give double-circuit effect without separate heat exchanger. Surge tank provides for expansion of water in closed circuit.



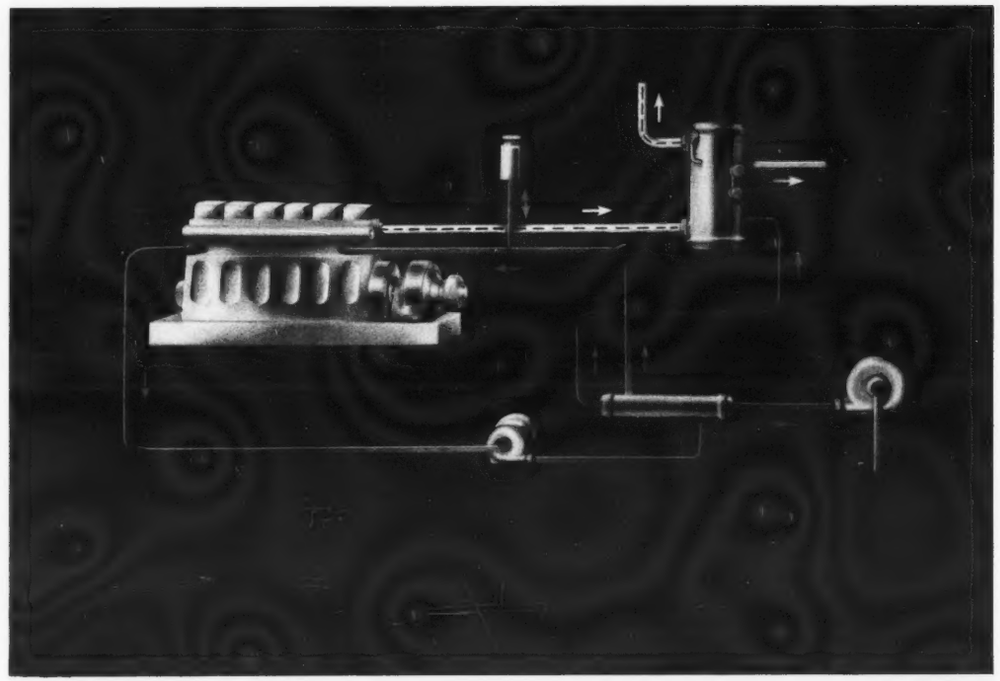
DIESEL 5 Recovery of heat from jacket water is simple, requires almost no equipment and is easily justified wherever effective use may be made of hot water. Simplest system is direct hot-water supply from jacket to tank. Water must be non-scale-forming. Unless demand for hot water is greater than flow needed to hold desired jacket temperature, water has to be wasted.



DIESEL 6 Where water supply is not suitable for circulating through the jacket, addition of a heat exchanger separates pure- and raw-water circuits. Allowance must be made for about 10-F drop between jacket circuit and supply. Hookup shows surge tank to provide for thermal expansion and keep closed circuit full, but pressure-regulating and relief-valve arrangement may be used.



DIESEL 7 Usual diesel converts about ⅓ of fuel heat into useful output. This can easily be increased to more than ½ by recovery of heat in exhaust gas as well as in jacket water. Where there is demand for hot water, arrangement shown here, with exhaust-gas water heater, applies. Corrosion danger from condensed sulphur products limits cooling of exhaust to 300 F.



DIESEL 8 Exhaust gas may also be used to generate steam in a waste-heat boiler. Water is preheated in jacket-water heat exchanger. To sum up: diesels supply low-head heat from jackets (150 F or less) and high-head heat from exhaust gas. Heat can be used in process or space heating, or for fuel preheating, lube settling or feed heating in steam-diesel combinations.

ELEMENTS

"First choose a wife, then select her apparel" runs the old Chinese proverb. Translated into today's power-plant language, it means doing first things first – for example, choosing a basic hookup before plunging into details. This applies not only to details of actual piping and equipment, but also to certain secondary hookups or hookup "elements" – the arrangements for condensing and cooling, evaporating, feedwater treating, and so on.

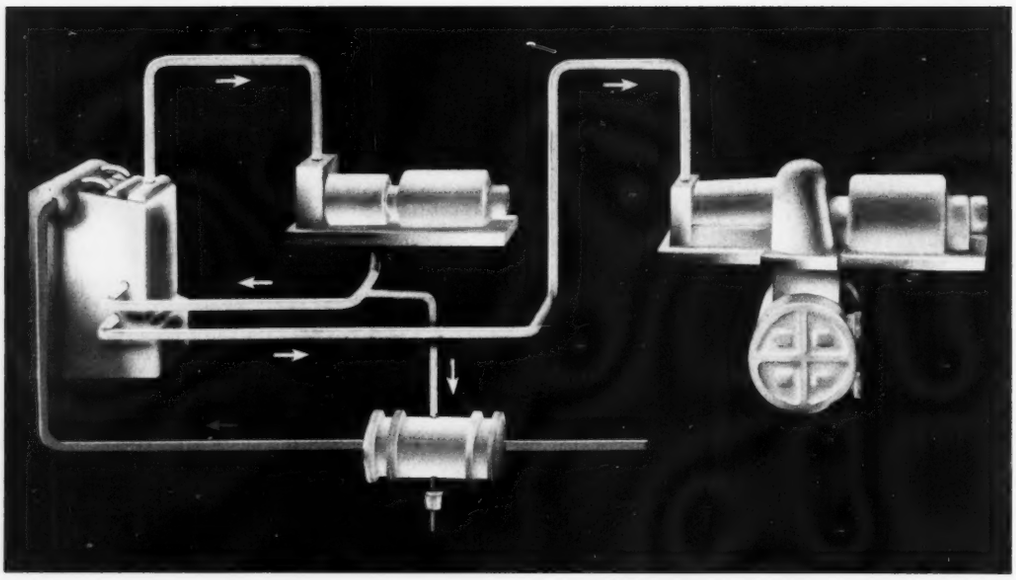
Thus the basic plan selected may call for condensing operation without requiring an immediate decision as to the *method* of condensing or the exact cooling-water circuits. This element, and many others, can best be studied later as a separate problem.

At both ends of the line, separate treatment keeps things simple, avoids confusion and reduces chances of errors and omissions. Yet, in the final analysis, these "wheels within wheels" are just as important as the main hookup and must have the same consideration. Hence this "Elements" section. Employing substantially the same technique as Evolution, the pages immediately following picture practical arrangements of each functional element, with text to tell concisely where each fits best and why. Functions thus reviewed by actual models include condensing and cooling, feed heating, evaporating, pressure reducing, desuperheating, steam storing, reheating and continuous blowdown.

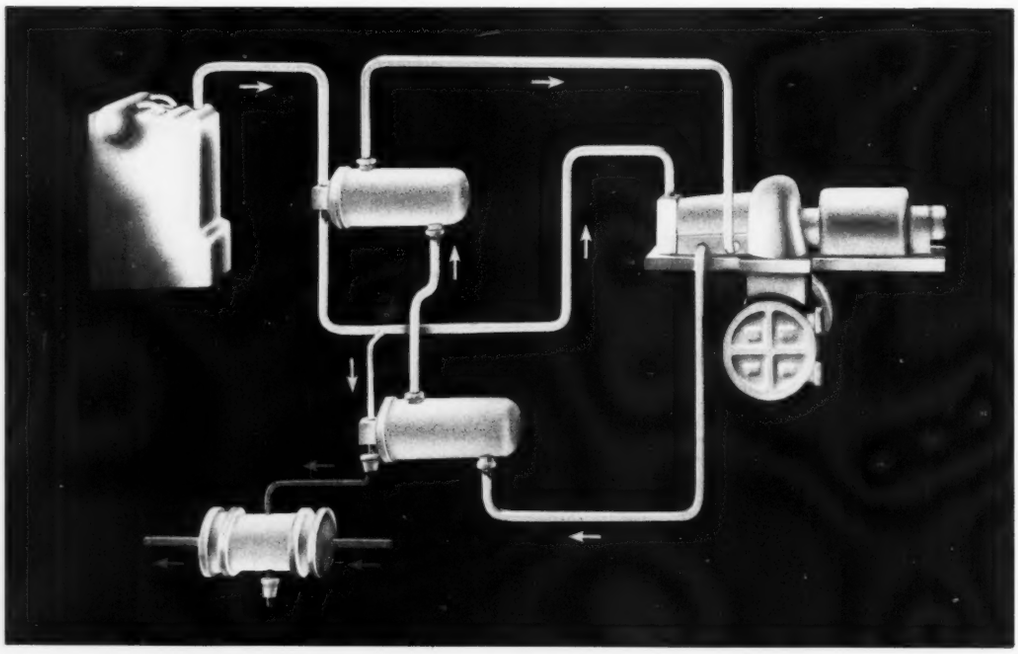
The power engineer who has carefully traced the steps of Evolution, and then studies the variations of Elements, is ready to "roll his own" hookups in almost endless combination. Practically any selection of elements can be applied to most of the basic hookups already shown. Some of the resulting combinations, as developed by other engineers, will be found in the actual modern plants pictured in "Applications."

Elements does something more than guide individual hookup thinking. With these model photographs spread before them as a new and graphic hookup language, manager, engineer and operator can agree on the arrangements best suited to their needs, knowing that all are talking about the same thing. Those who have learned the inadequacy of ordinary language in such situations will grant that "one picture is worth ten thousand words."

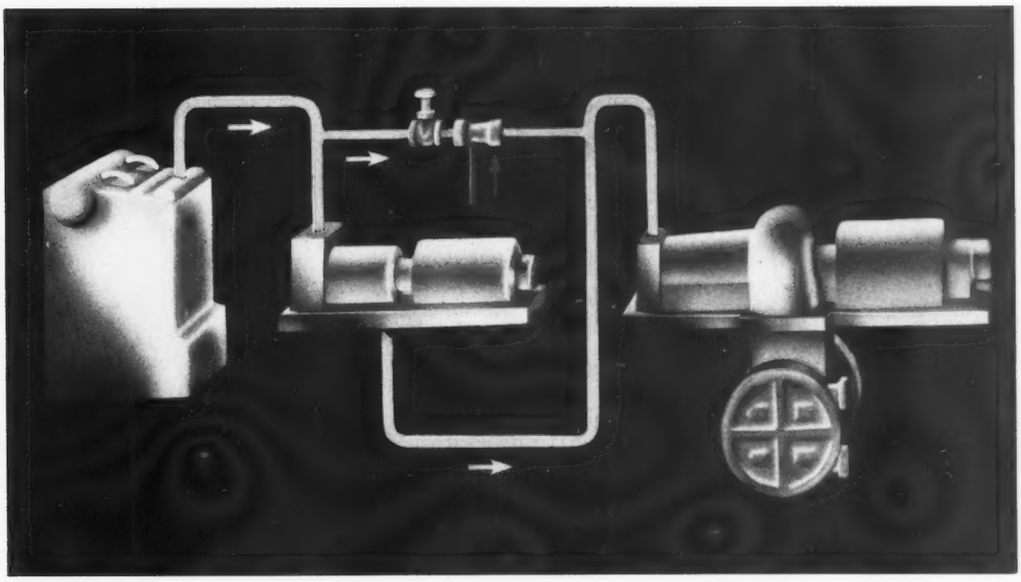
KEY TO ADDITIONAL MODELS



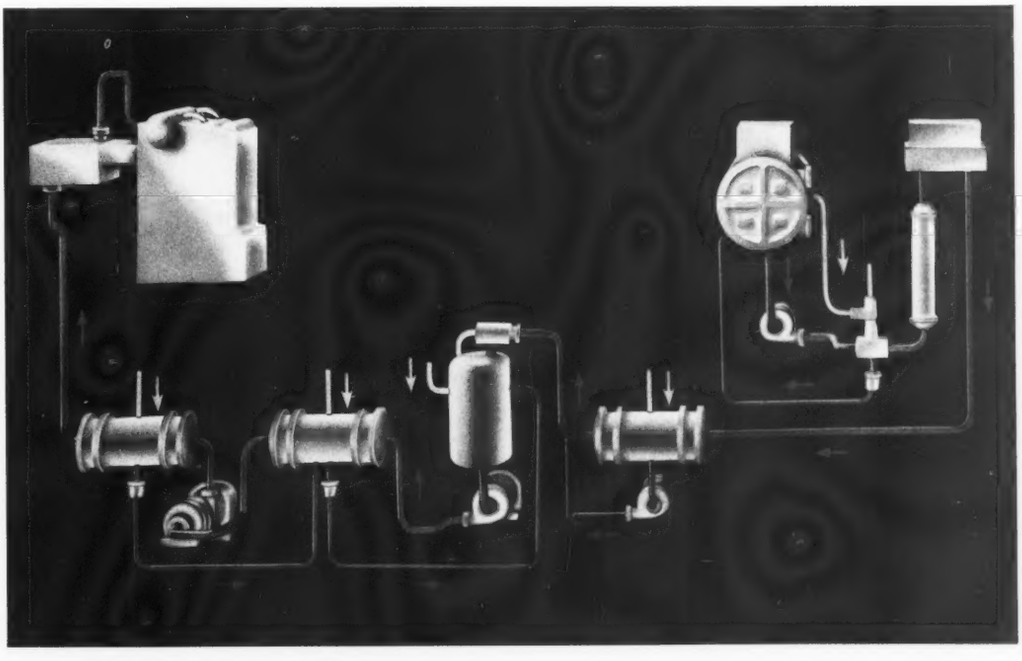
REHEATING — GAS When increased efficiency is sought by use of high throttle pressure, steam may be returned at intermediate pressure to boiler for resuperheating. This eliminates excess moisture in last stages of expansion and makes extremely high initial temperatures unnecessary. Reheating tubes in furnace resemble superheater. Steam from return line supplies highest-pressure feed heater.



REHEATING — STEAM Extensive steam-return piping of gas-reheat hookup is eliminated by steam reheat. Separate reheaters raise temperature in two steps, first by condensing small amount of h-p steam and then by transferring heat from main throttle flow. Condensate may be trapped to any convenient point. Taking and returning steam to same turbine casing is usual reheat arrangement.

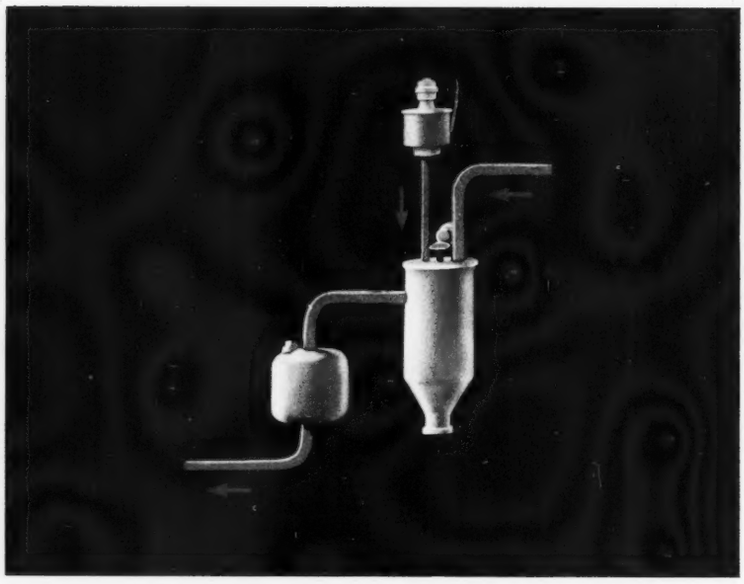


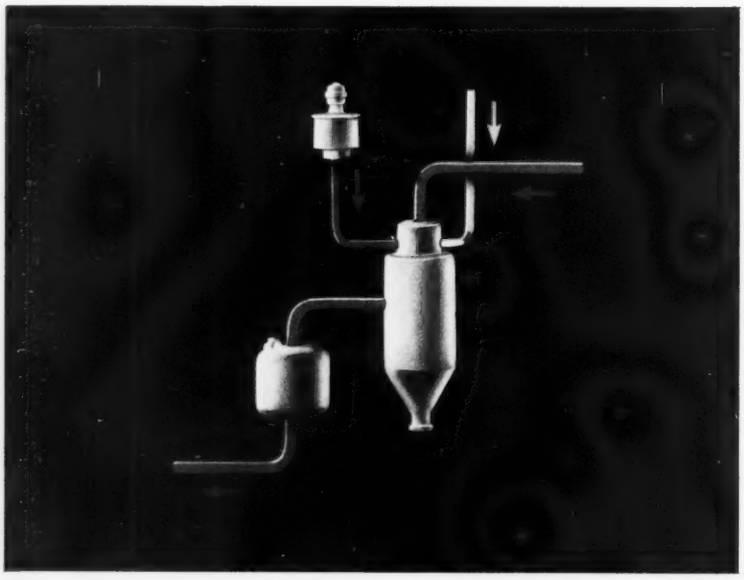
REDUCING, DESUPERHEATING This combination makes h-p boiler capacity available to l-p units in event of top-turbine outage, holding temperature at safe limit for old machines; also permits supply of low-pressure and -temperature process from h-p steam lines. Desuperheater cooling water must be free from solids and supplied at a pressure slightly in excess of low-side steam pressure.



FEEDWATER HEATING Illustrates basic idea of step-by-step water heating, partly by waste heat (air-ejector condenser, oil cooler, air cooler, etc), but chiefly by steam that has done work in prime movers or auxiliary drives. Feedwater receives heat from sources of successively higher temperatures, conserving valuable high-head heat. First cost limits number of heat sources worth using.

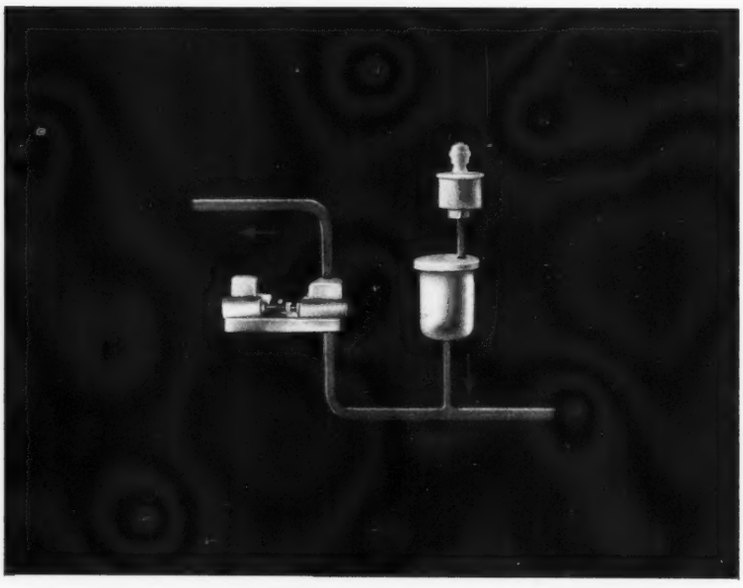
FEED TREATMENT 1 Sedimentation tank, pressure filter, and chemical mixing tank make up this simple circuit. Solution, prepared in small tank with motor stirrer, is added to sedimentation chamber where reactions take place. Filter, using sand or other granular material, removes organic matter and precipitated solids.

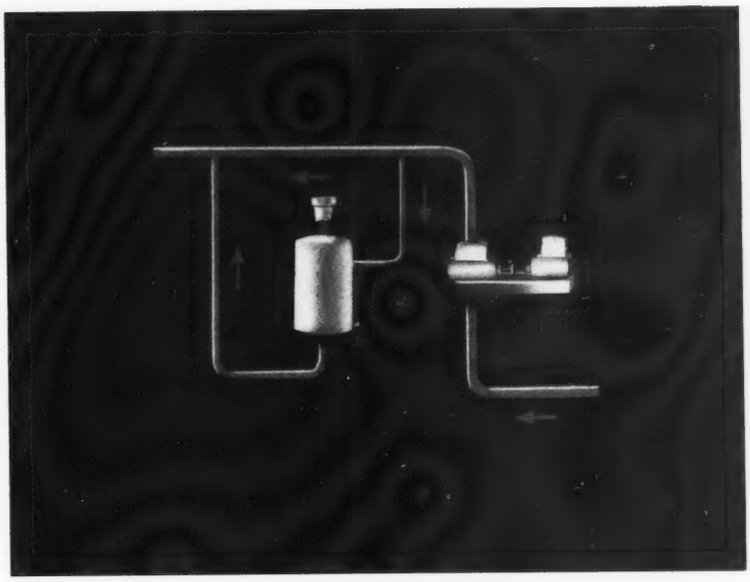




FEED TREATMENT 2 Some water supplies are more suitably treated by the hot process, using lime and soda ash. Steam supply to heater section of tank raises water temperature to desired point. Preparation and addition of treatment chemicals is similar to arrangement in preceding hookup, and filtration is also the same.

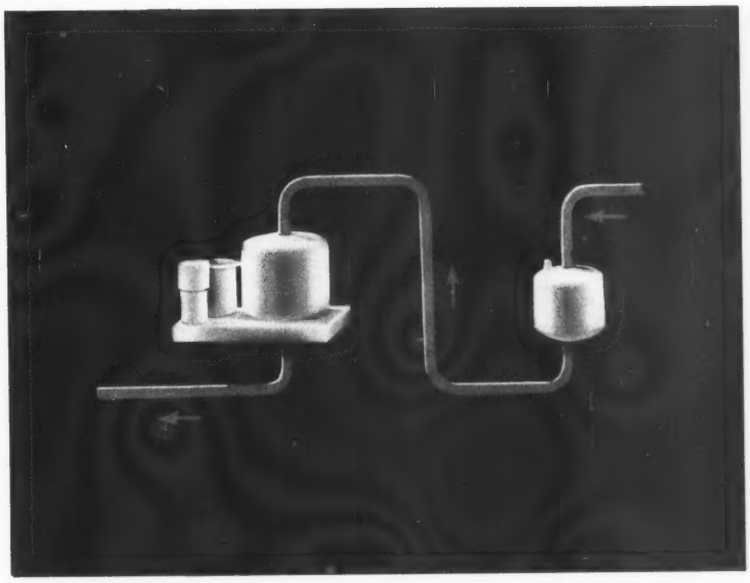
FEED TREATMENT 3 When chemicals are to be added to maintain stated conditions in boiler drum, simplest method of introduction is at suction of boiler-feed pump. Solution, prepared in mixer, passes into feed tank, which can be put under slight pressure or elevated so that solution flows into feedwater line at controlled rate.

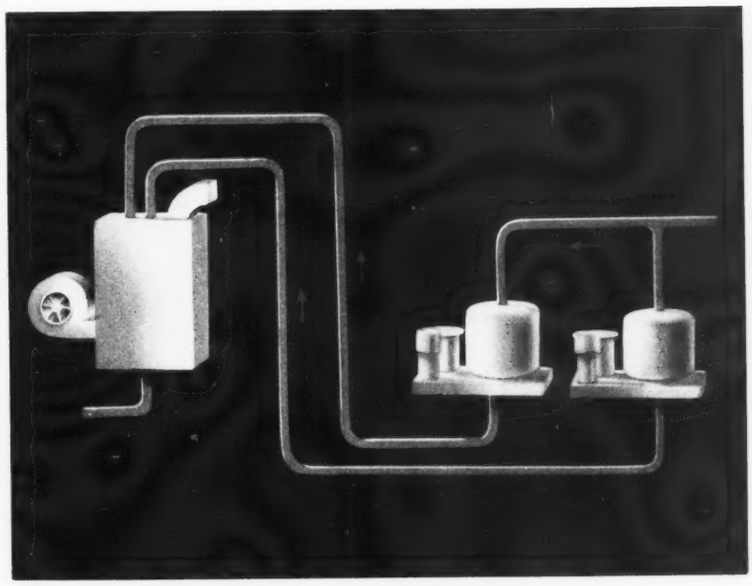




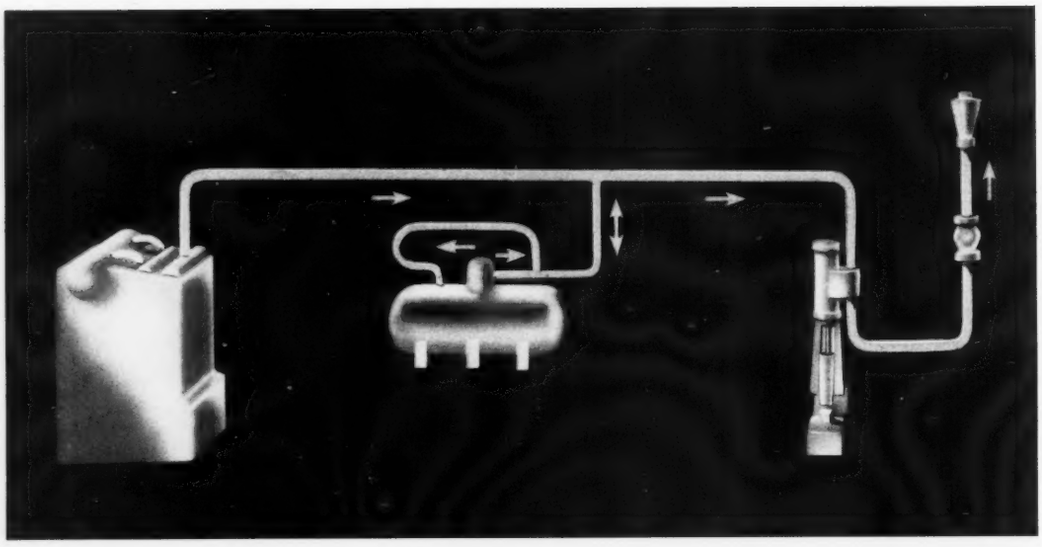
FEED TREATMENT 4 Illustrates treating on discharge side of feed pump without solution pump. Chemicals are placed in tank with connections to main line closed. With tank openings shut, and connections opened, solution flows at controlled rate due to pressure drop. Orifice or restriction in main line increases flow.

FEED TREATMENT 5 By process of base exchange, zeolite changes scale-forming constituents of water to harmless sodium salts. Softener resembles pressure filter, with zeolite replacing filtering material. Zeolite must be regenerated occasionally with salt brine; process can be controlled automatically. Filter usually precedes softener.

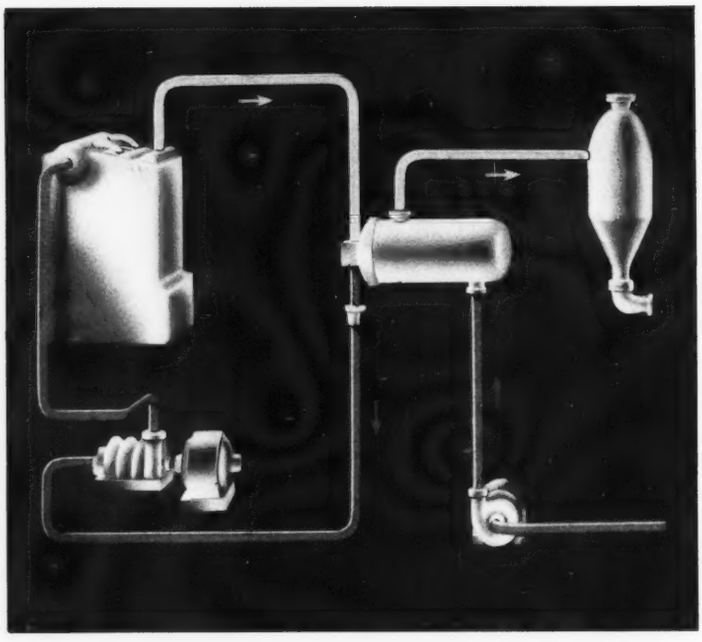




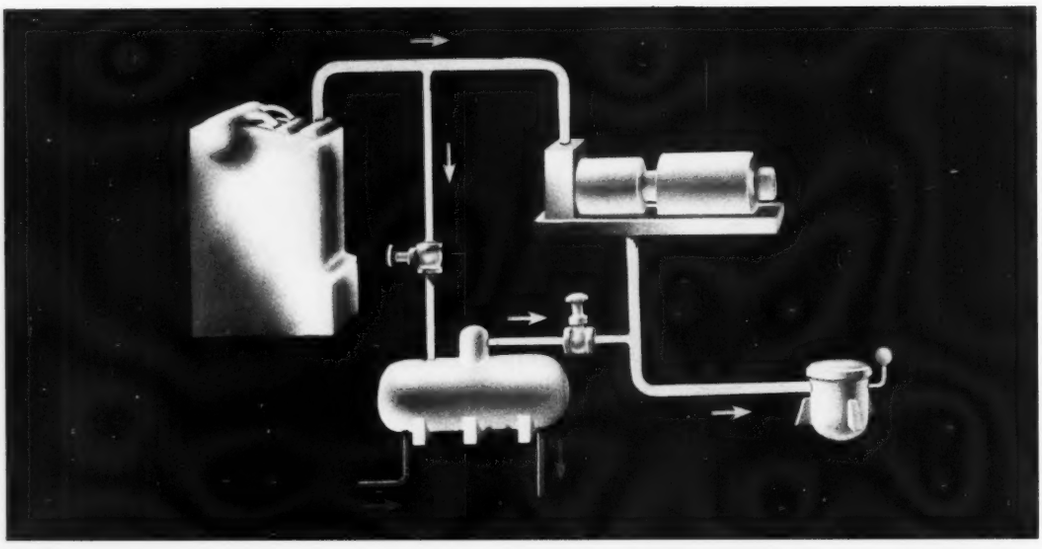
FEED TREATMENT 6 This arrangement of two chemical treatment reactions similar to zeolite delivers feedwater with less total soluble salts than it originally contained, by changing them into gas form. Separate lines connect treatment units with degasifier in which gas is removed. Filter may be added to circuit ahead of treatment.

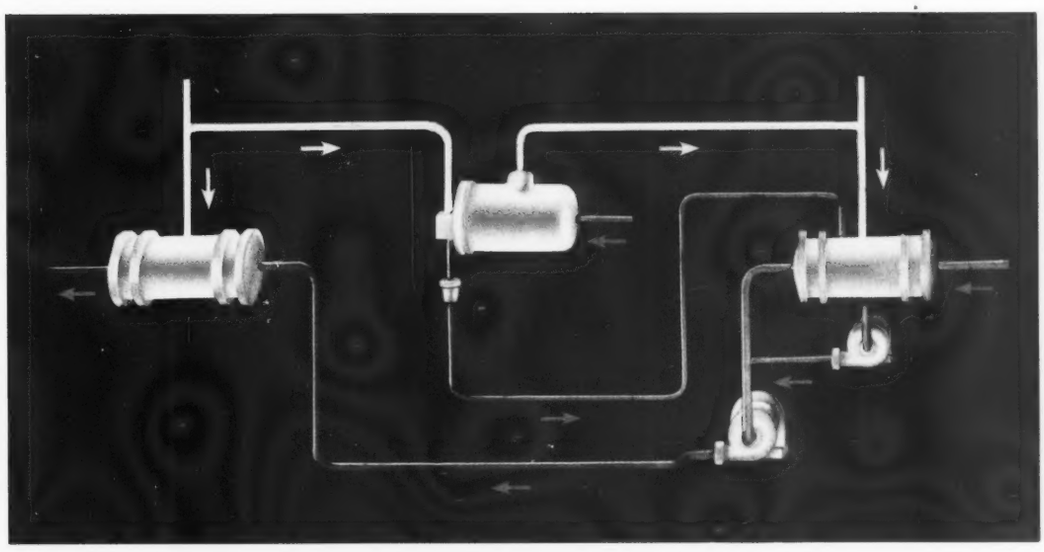


STEAM STORAGE 1 Where process steam demand fluctuates widely, an accumulator helps smooth boiler load. A slight increase in pressure, when use is light, forces more steam into accumulator, which is simply a reservoir of water ready to boil when pressure is reduced by heavy demand.



STEAM STORAGE 2 Supplying steam at higher pressure than required by process increases accumulator capacity, as pressure can float over full range between supply and process pressures. Control valve maintains constant output pressure; inlet is throttled to minimize demand on boiler.

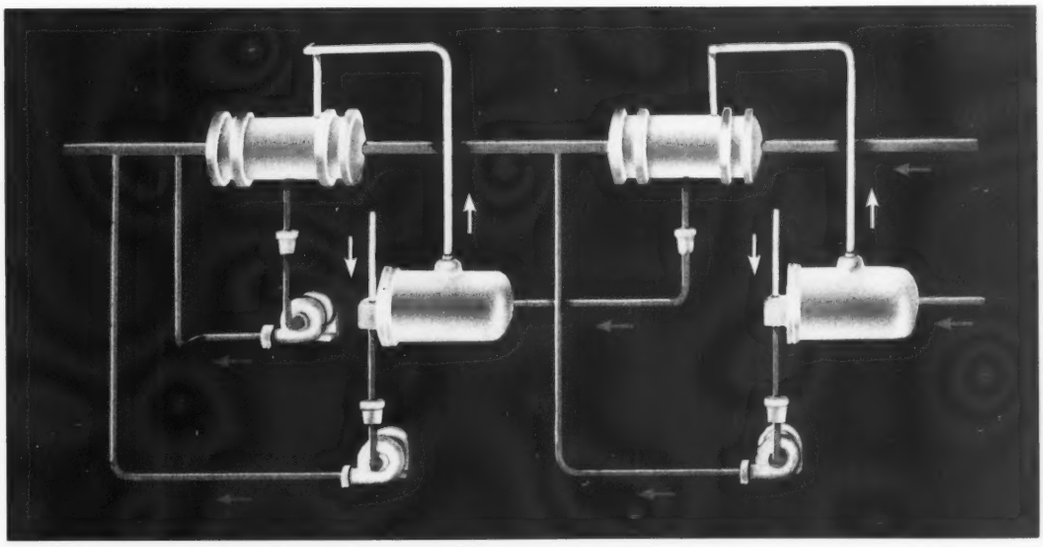


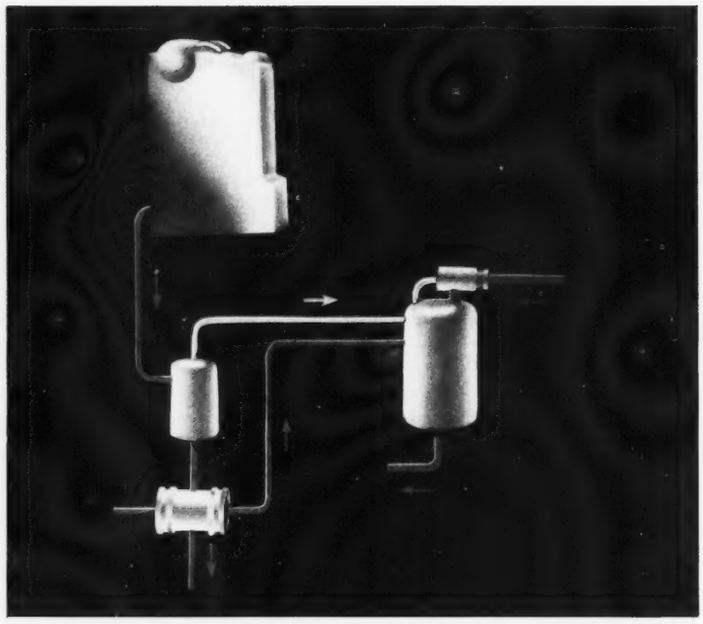


STEAM TRANSFORMER To permit operating boiler with little makeup, steam for process can be made in a steam transformer (actually an evaporator). Heat from boiler steam flowing inside coils evaporates raw water supplied by pump. Coils can be arranged for easy cleaning of scale.

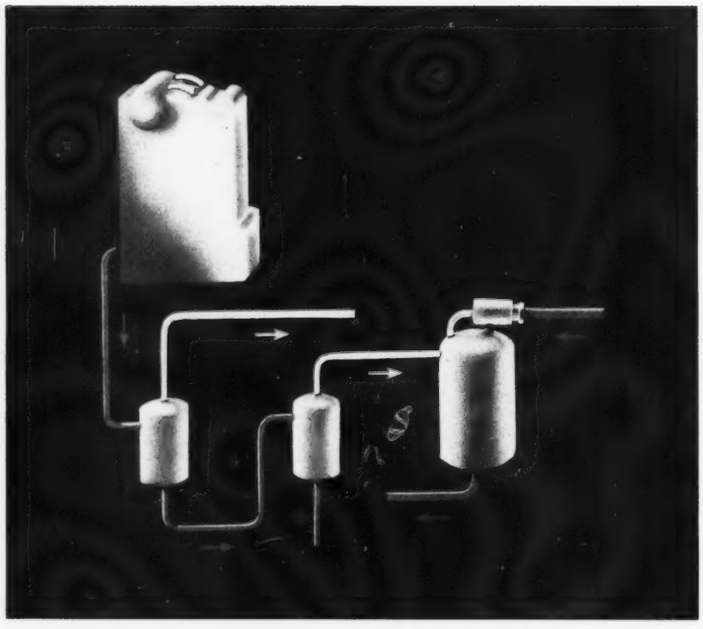
EVAPORATING 1 With this arrangement, makeup can be distilled by bleed steam supplied to evaporator coils. Condensate is trapped to next lower-pressure heater or to separate evaporator condenser, and steam from evaporator replaces bleed. It may pay to preheat makeup in heat exchanger.

EVAPORATING 2 With bad water, some solids may be carried over on the first distillation, so second stage is provided. This is usually operated at slightly higher pressure than first stage to permit heat recovery by passing main feedwater flow through the two evaporator condensers in series.

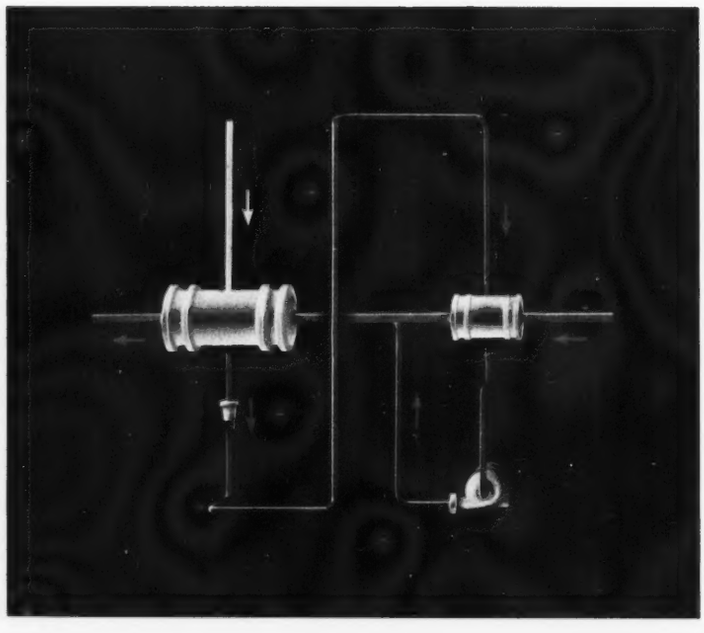




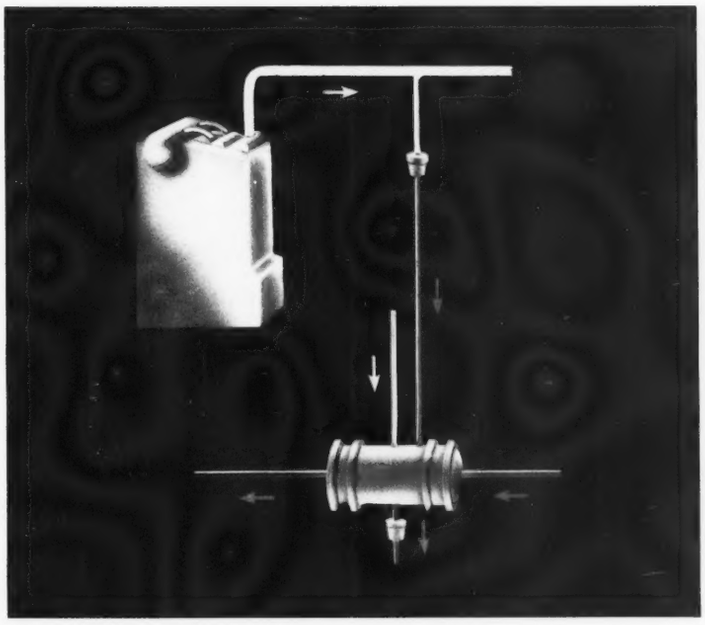
BLOWDOWN 1 A worthwhile amount of heat and about one-third of blowdown water can be recovered with this arrangement. Pressure reduces to about atmospheric in flash tank; flashed steam, containing no solids, passes to heater. Remaining blowdown can be further cooled by makeup or feedwater before wasting.



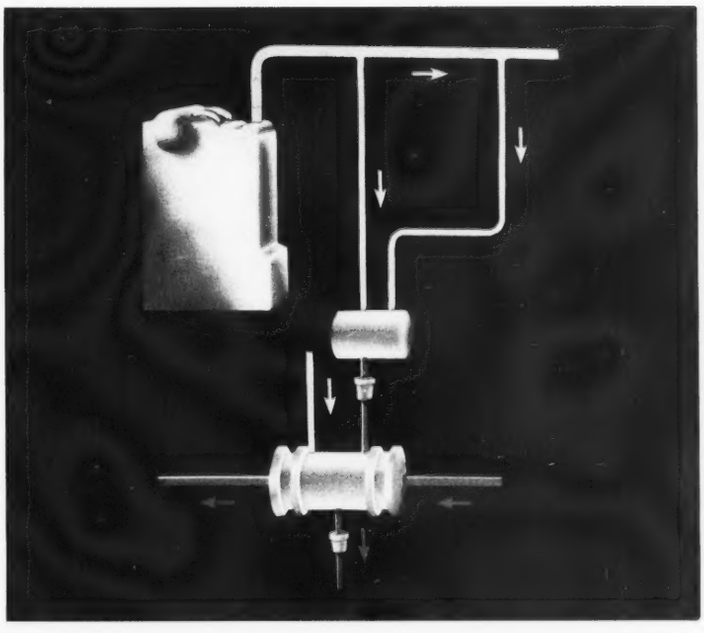
BLOWDOWN 2 Operation at high boiler pressures sometimes justifies 2-stage blowdown. Steam flashes at intermediate or process pressure in first flash tank, and at or near atmospheric in second tank. Heat from remaining blowdown can be recovered in heat exchanger before going to waste, as shown in first blowdown hookup.



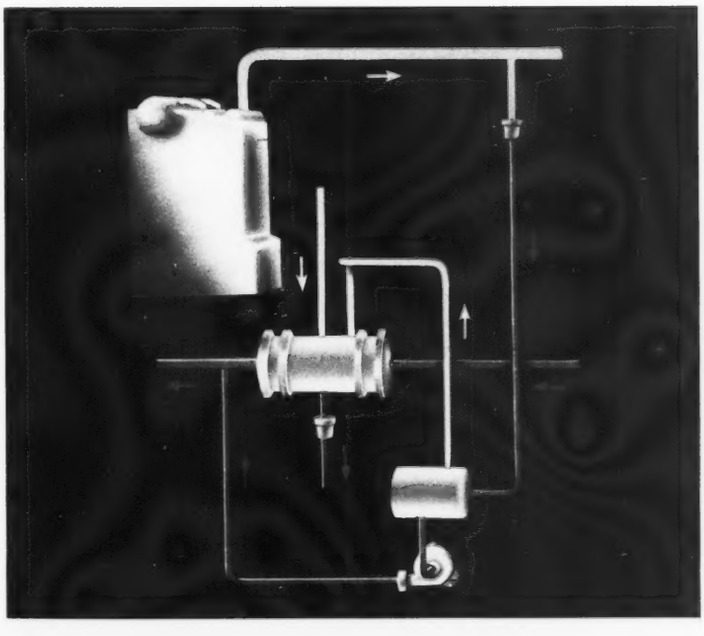
DRIP COOLER Condensate from feedwater heaters is usually trapped to next lower-pressure heater or pumped to feed line ahead of heater being drained. Heat in condensate may be used at slightly higher temperatures if piped to drip cooler ahead of next lower-pressure heater, as shown. Cooler drains may be pumped or trapped.



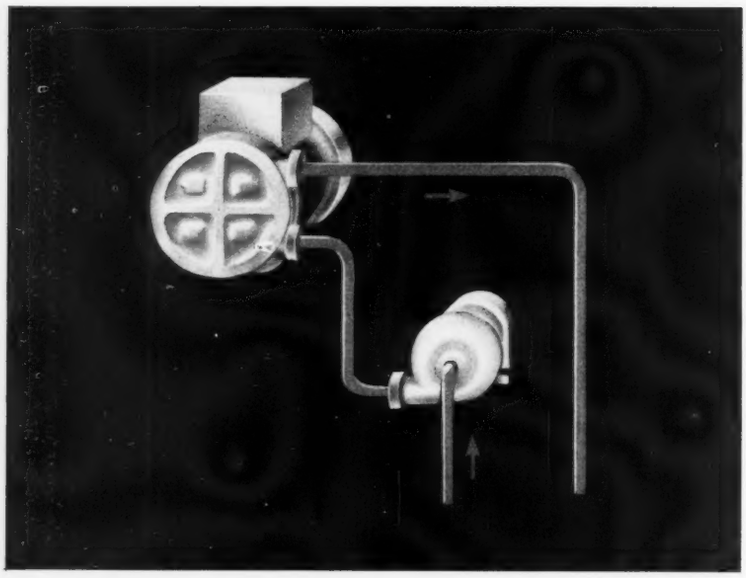
STEAM-LINE DRAINS 1 Main steam lines should be provided with drain connections for starting up and to guard against water pockets or slugs of carryover. Simplest arrangement for disposal is to trap drains back to a convenient heater, as shown, recovering most of heat and all of water. Orifice may be used in place of trap.



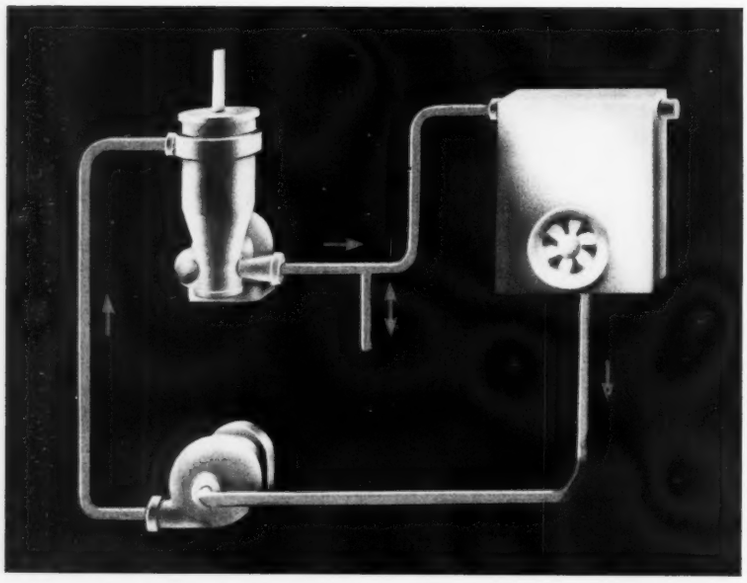
STEAM-LINE DRAINS 2 In this alternative hookup, a receiver built to withstand full steam-line pressure collects drainage from several points and provides storage for slugs of water which would otherwise require a trap of large capacity. A small trap or orifice handles discharge from receiver to any convenient heater.



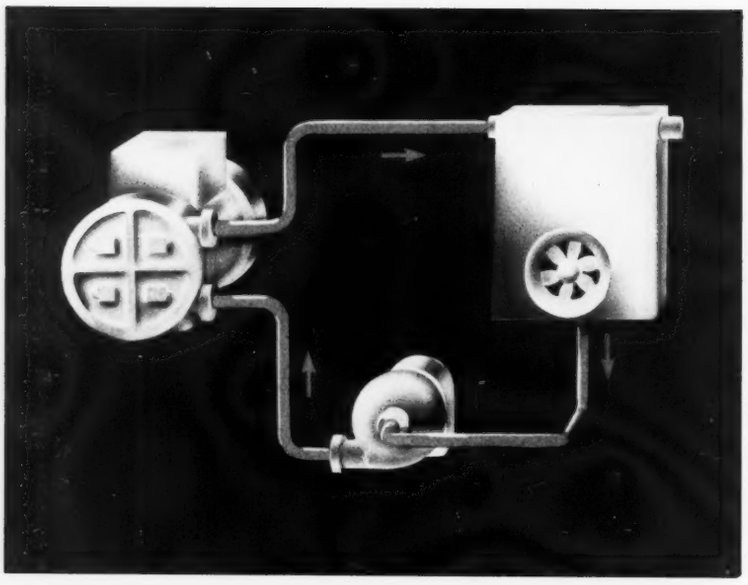
STEAM-LINE DRAINS 3 To simplify handling drips and drains at different pressures and temperatures, from various parts of plant, drainage can be passed through traps or orifices to a flash tank. Flash steam goes to heater, and water is pumped into feed circuit; this avoids dumping large quantities of water into heater.



CONDENSING 1 Simplest circulating-water arrangement can be used when ample supply is available from lake or river. Pump, usually centrifugal, supplies condenser; outlet pipe returns warmed water to point far enough from intake to prevent recirculation. Since water is returned to same elevation, pump need only overcome friction loss in pipe and condenser.

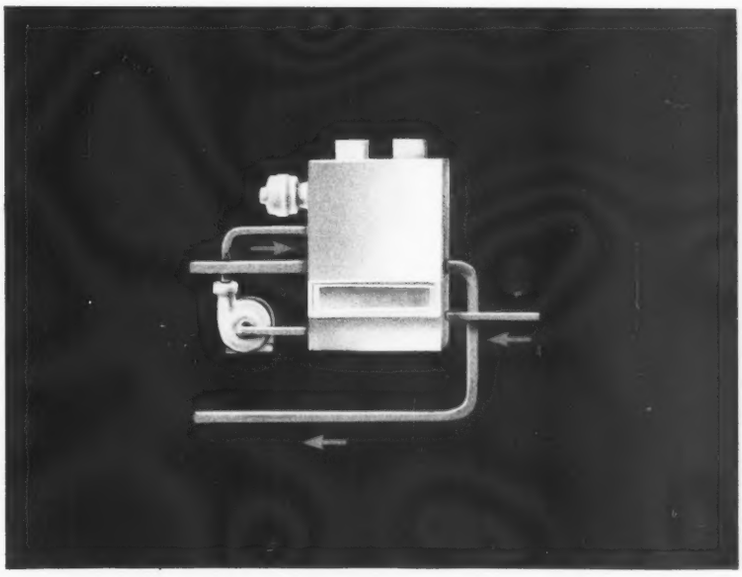


CONDENSING 2 Since steam and condensing water mix in jet condensers, an amount of water about equal to main steam flow is lost, either carried away with circulating water in an open circuit, or evaporated from cooling tower or spray pond in a closed circuit. Low first cost and small space required for installation are advantages of jet condensers.

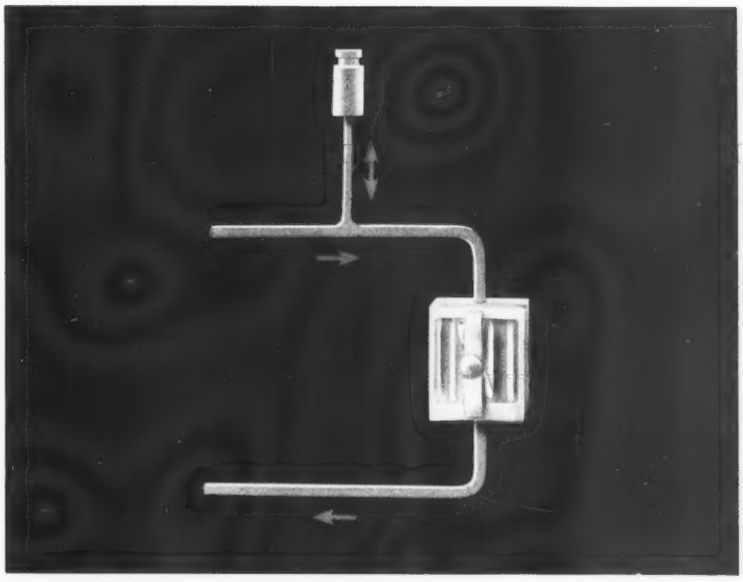


CONDENSING 3 Where condensing-water supply is limited or expensive, a surface condenser can be used with cooling tower or spray pond. Most of cooling is by evaporation; latent heat required to vaporize portion of water is supplied by main body of water, thus lowering its temperature. Makeup for evaporation loss is usually less than 2% of total flow.

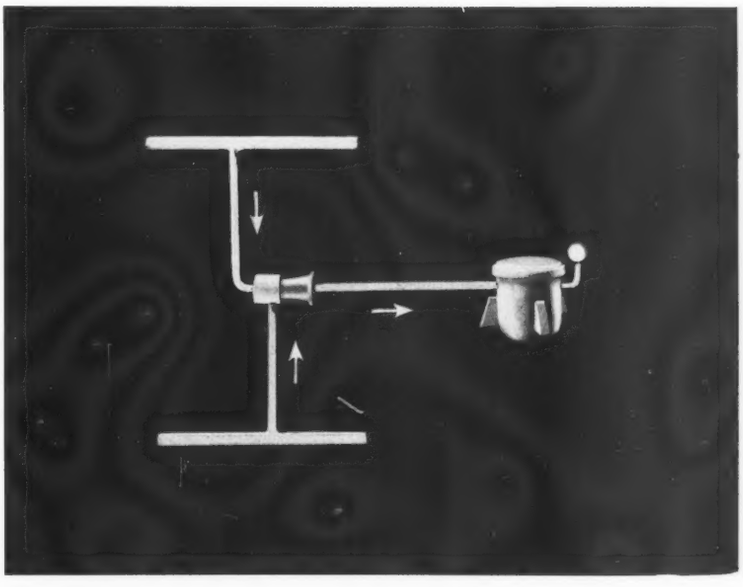
CONDENSING 4 Evaporative condenser cools by evaporation, as do towers and ponds, but fluid to be cooled or condensed flows in closed coils located in an air stream. Water, pumped from sump in base, sprays over coils; makeup is added in sump. In effect, an evaporative condenser combines in a single unit a surface condenser, or heat exchanger, and a cooling tower.



RADIATOR COOLING Heat can be rejected from condensing or cooling circuits by direct radiation from closed coils. Large capacity in small size is obtained by using finned tubes and forced air circulation. Warmed air sometimes can be utilized for building or factory heating. Surge tank keeps system full of water and provides for thermal expansion.



THERMOCOMPRESSOR To obtain steam at a pressure between available levels, a jet of steam at higher pressure may be used to compress a proportionate amount of lower-pressure steam in a device similar to an evactor. Use of small amount of valuable high-pressure steam thus makes available to process heat units from less valuable l-p steam.



APPLICATIONS

We come now to brass tacks. "Evolution" was hookup logic. "Elements" reviewed important details. The following nineteen models are practical applications, each representing the mainflow circuit of an actual plant, recently built or modernized.

These samples reveal an astonishing variety of ways to do a power job. Many of the differences are easily explained by special requirements or local conditions. Yet, just as often, there are wide hookup variations among plants where all surrounding factors — except one — are practically equivalent.

That one is the human element. No two designers think exactly alike. Even the same engineer, in the same year, will design two quite different plants for two similar situations. This is to be expected, because owner and operator definitely influence the design. One owner, for example, will invest the last cent that will yield an appreciable return. Another refuses to spend money for "refinements", or perhaps he just hasn't the extra dollars. Operators, too, have their preferences, which the wise designer cannot disregard.

Such elusive factors are always the main difference between practice and theory. They distinguish machine design from geometry, finance from arithmetic, actual plant hookups from the simple engineering logic of Evolution.

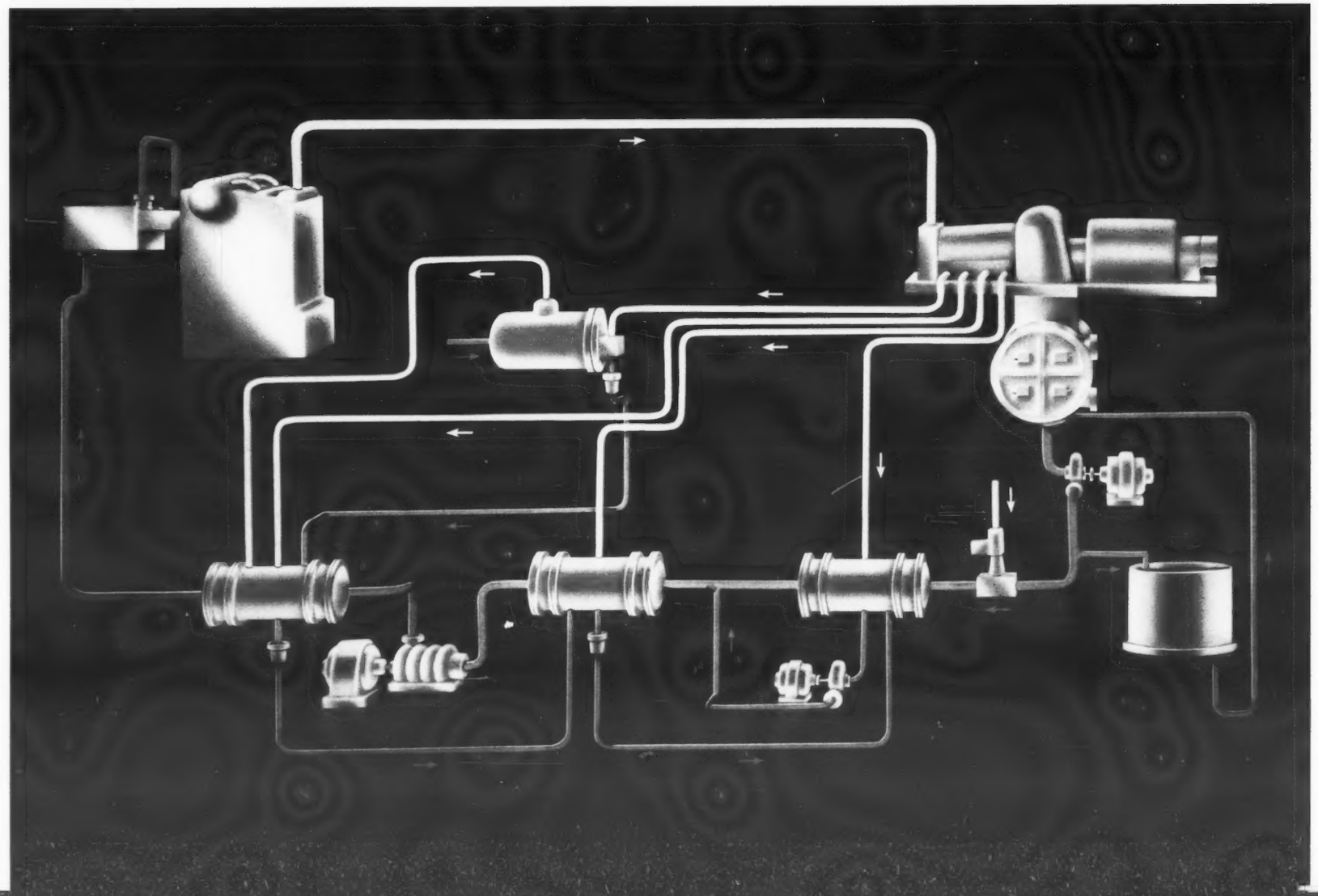
The ability to handle these intangibles, largely human and financial, cannot be gained through any simple routine of formal study. It must come from experience — one's personal experience plus that of other men who have labored long and hard.

To speed the reader's understanding of the experience of other engineers, the following pages present nineteen recent hookup achievements of nineteen good designers faced with nineteen assorted sets of circumstances. The actual plants, thus reproduced as hookup models, include central stations and industrials. They vary widely in size and complexity, kind of industry, special conditions and hookup solutions.

For clearness, every detail has been simplified. Where several boilers or turbines are of the same type, and take the same place in the hookup, they are shown as a single unit. Process models are purely symbolic; for example, a digester represents any process using high-pressure steam. In some cases such details as feed treatment and blowdown are included to illustrate types; in others they are omitted for simplification.

These are necessary sidelights. To conclude with the main idea, here is an opportunity to see how able designers season hookup logic with common sense and imagination to fit the facts of life.

CENTRAL STATION 1 Typical new high-pressure condensing plant needs no compromise with existing heat balance. Three stages of feedwater heating raise temperature to 300 F entering economizer. Top bleed point supplies evaporator from which both steam and condensate enter feedwater system at high-pressure heater. Large condensate-storage well takes reserve supply of makeup and permits intermittent evaporator operation.



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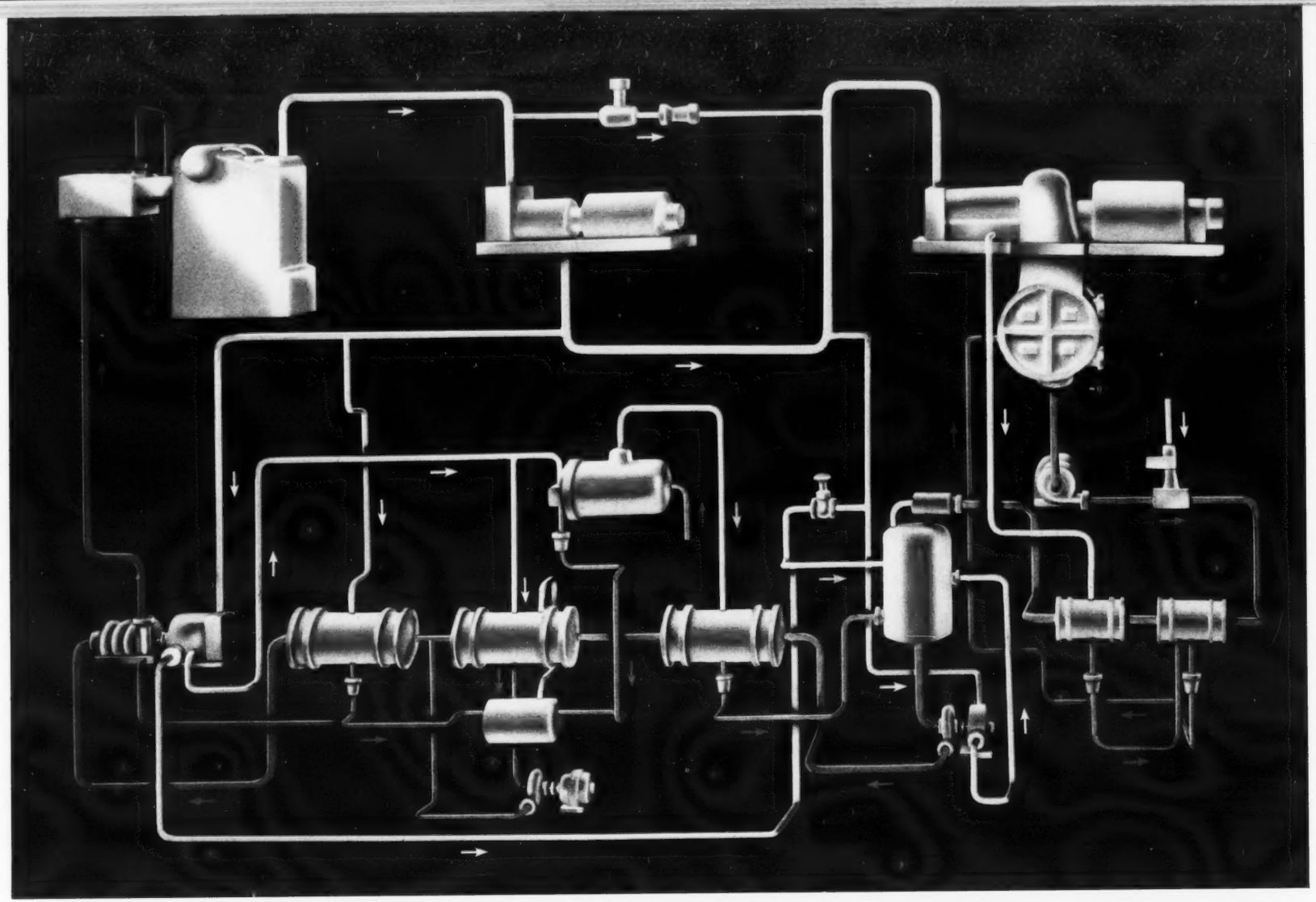
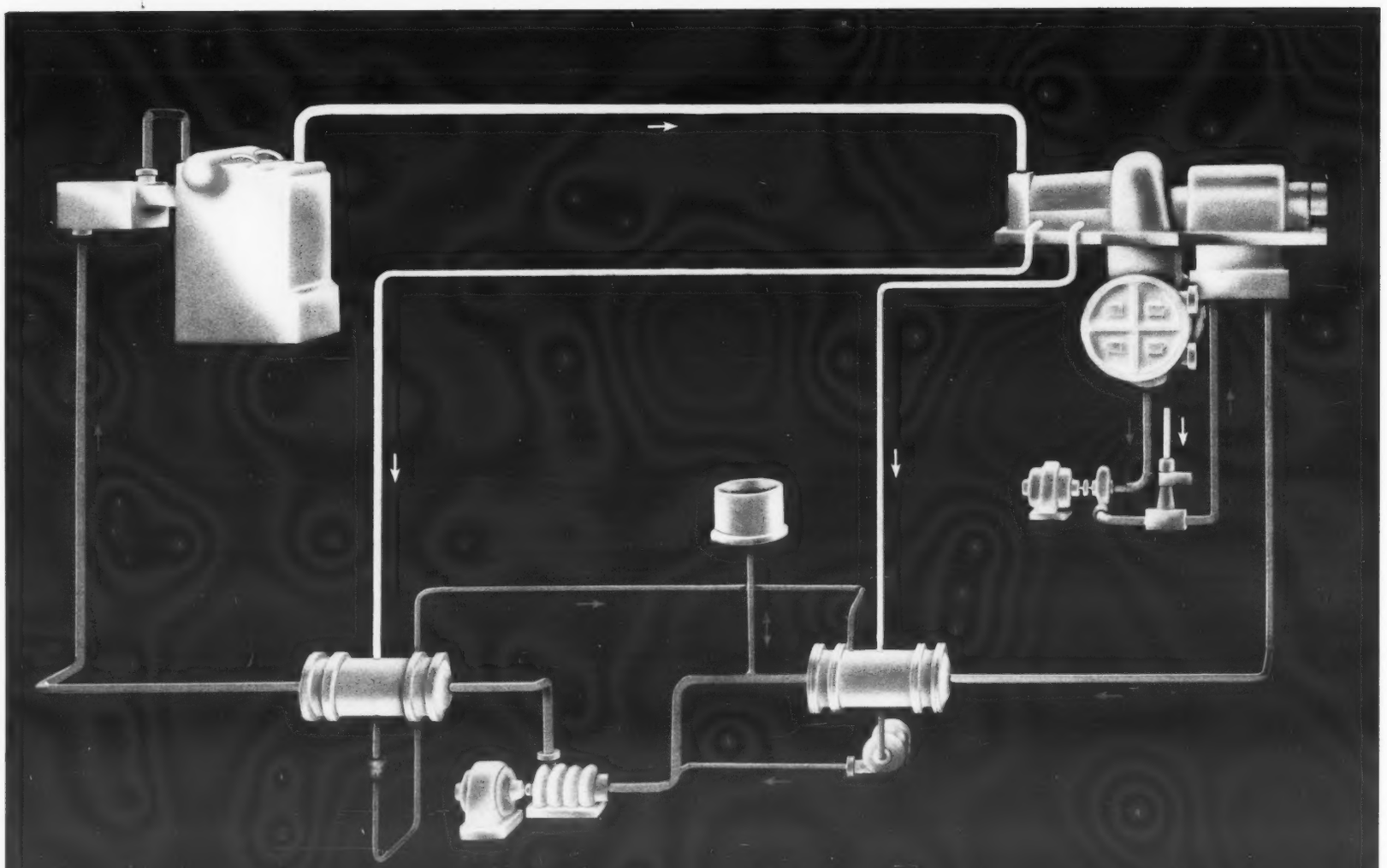


CENTRAL STATION 2 This high-pressure top illustrates tie-in with existing heat balance. Old station with single bleed point is supplemented by feed heating in deaerating heater which takes auxiliary exhaust. Reducing valve insures adequate steam for deaeration in case of unbalance. Bleed point on boiler-feed-pump turbine supplies evaporator and intermediate-pressure heater. Flash tank collects heater drips and boiler-feed-pump bypass drain.

CENTRAL STATION 3 Moderate-pressure plants can have simple hookups, even with large-capacity turbines. This plant, not new, is shown as an example of the many plants that have simple design and low first cost. Condensate picks up heat from air-ejector condenser, generator air cooler and two heaters supplied with bleed steam. Auxiliaries are motor driven. Small surge tank in feedwater system is supplemented by a large storage tank, not shown.



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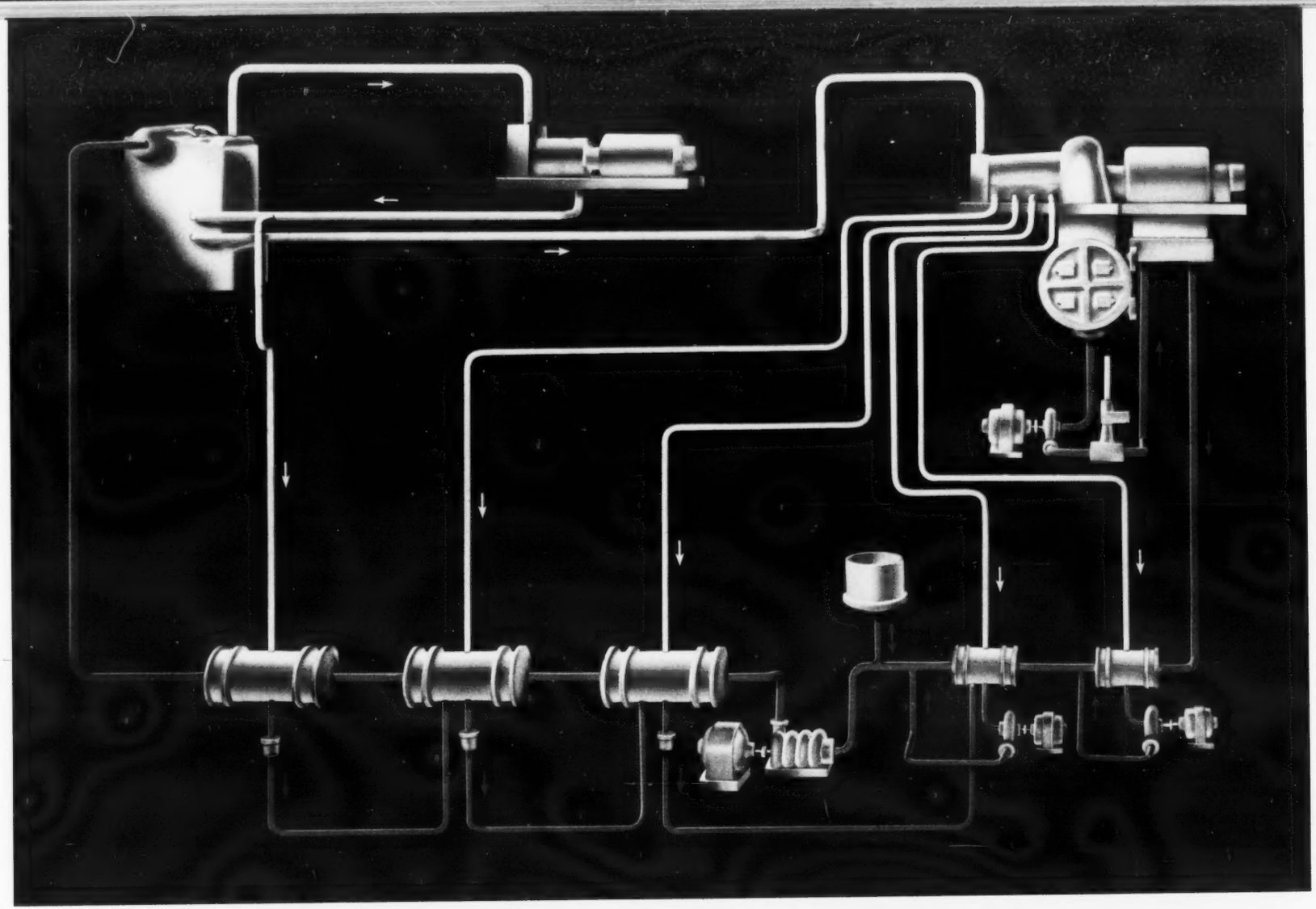
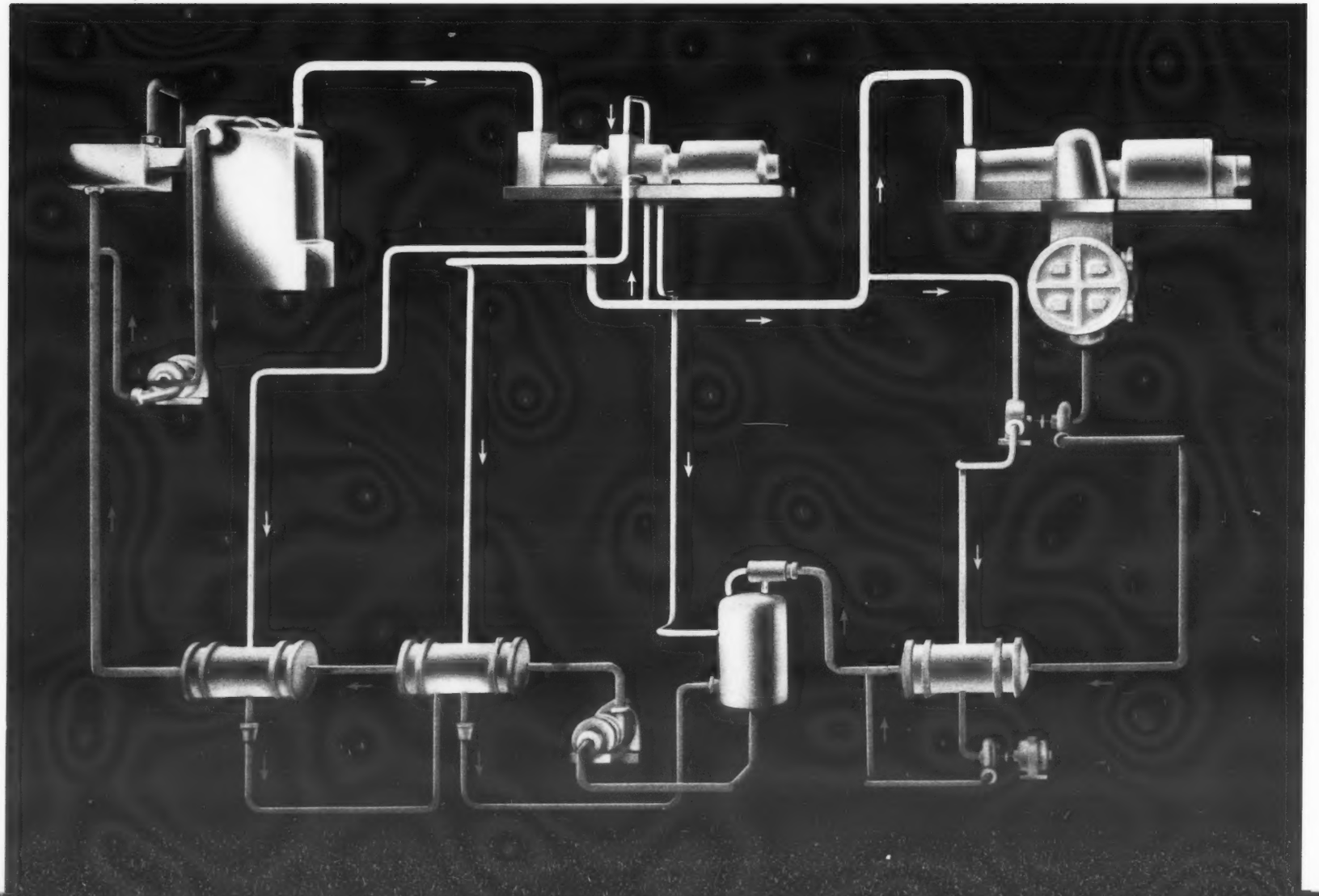


CENTRAL STATION 4 This large-capacity turbine installation obtains high efficiency without exceeding moderate steam temperatures by returning steam to boiler for reheating. Five stages of feedwater heating are used, four supplied by bleed steam and a fifth taking steam from the return reheat piping before it enters the boiler. Here, as in most new plants, heat balance is complete without exhaust steam from auxiliary drives; these are motor driven.

CENTRAL STATION 5 In topping this old plant, which has no provision for bleeding existing low-pressure turbines, steam needed for feed heating comes from a separate small turbine on the shaft of the new unit. This unit reduces top-turbine exhaust to suitable heater pressures, while adding about 7% to generator output. H-p feed heating is at crossover pressure. Note pump that recirculates drum water, containing feed-treatment chemicals, through economizer to prevent corrosion.



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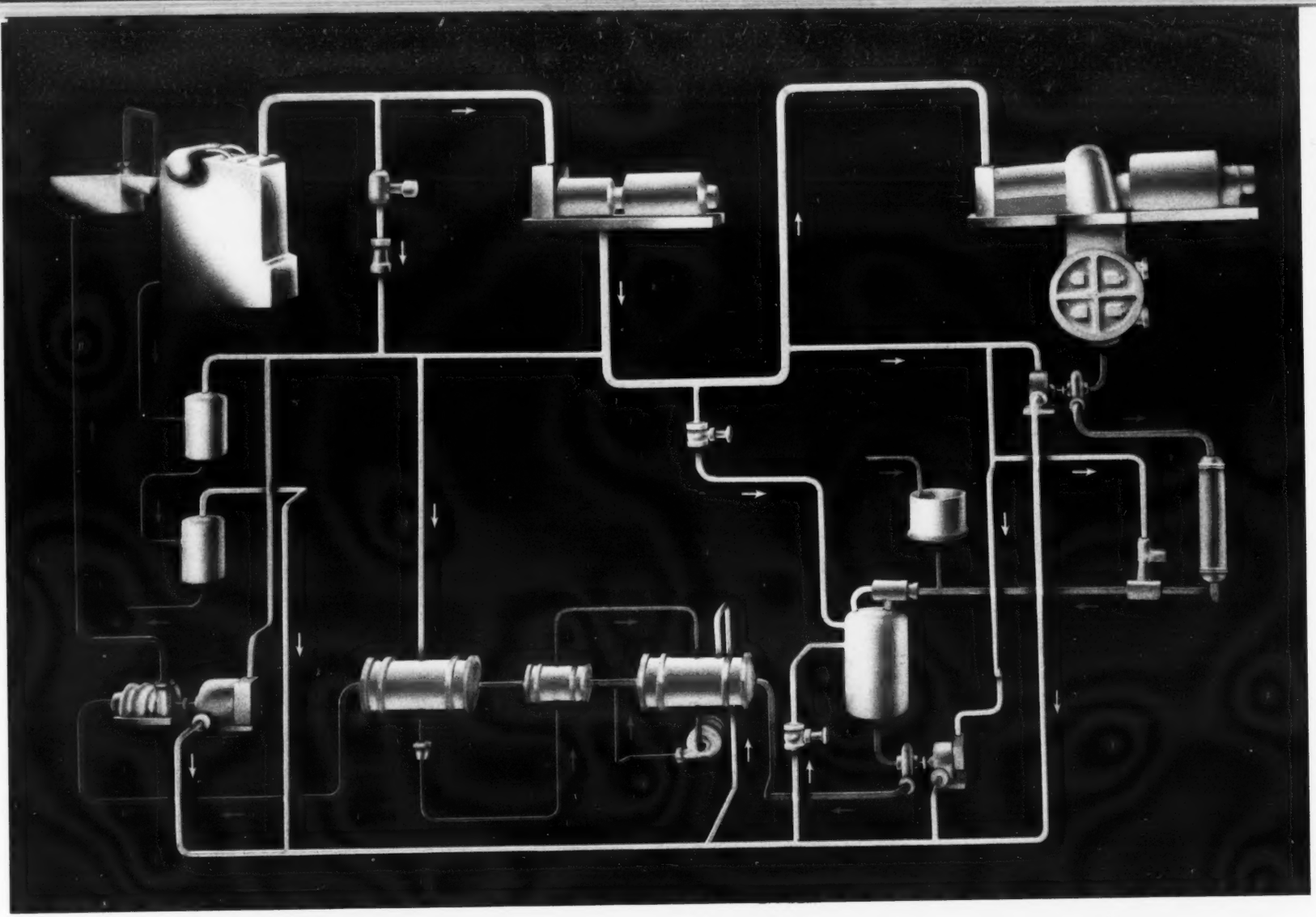
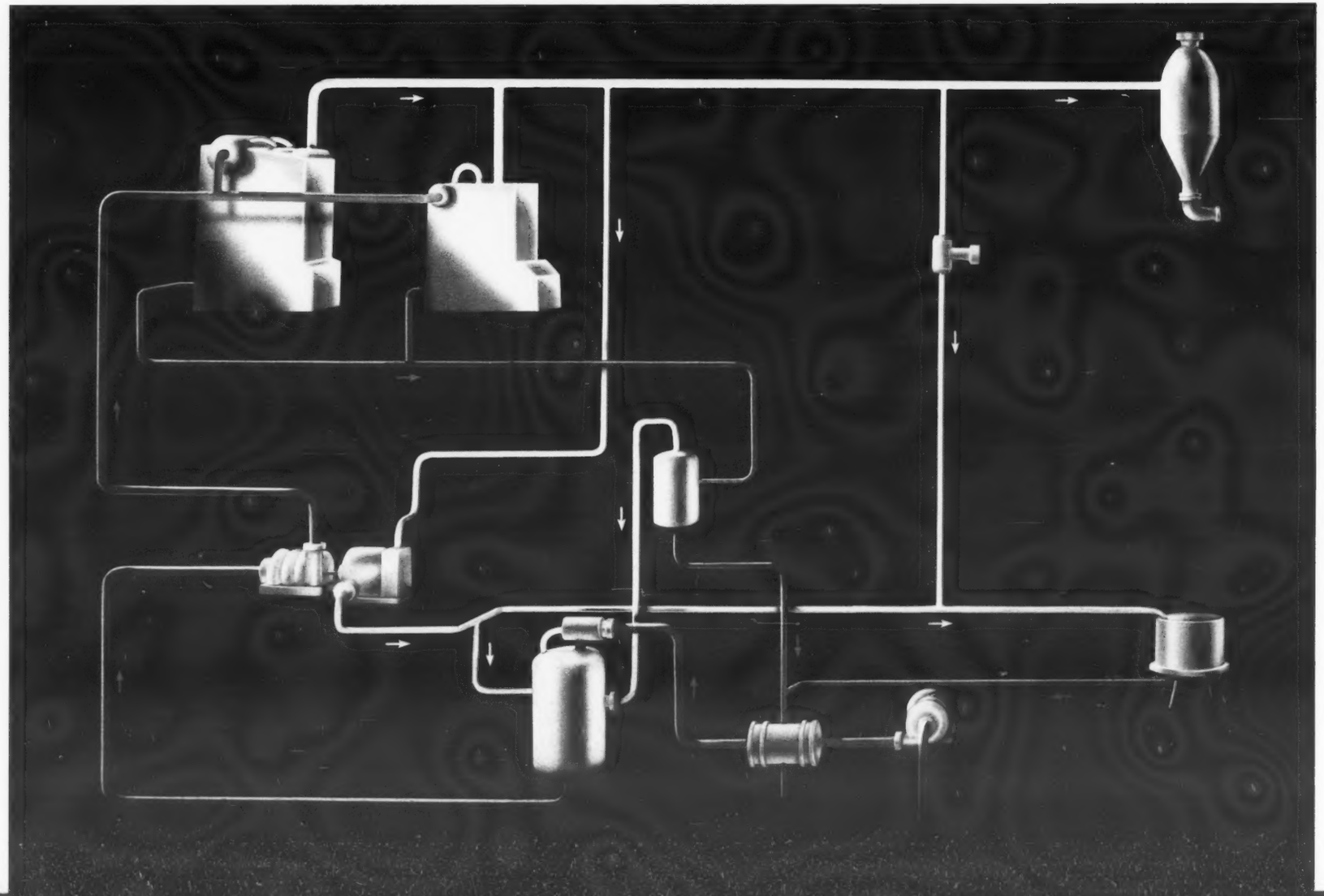


CENTRAL STATION 6 Here is another way to secure heat balance in topping an old plant — steam-driven boiler-feed pump exhausts to a modern deaerating heater. Available auxiliary exhaust from existing plant, and heat from oil cooler and air ejector, are fully utilized. Blowdown flashes twice, at crossover and lowest-heater pressures. Heat exchanger cools h-p heater drains before flash to l-p heater. Reducing valve from crossover makes up occasional deficiency in deaerator supply.

INDUSTRIAL 1 In this chemical plant, steam is generated for process, power purchased. New h-p steam-generating unit meets increased steam load, operating temporarily at existing plant pressure, but providing for future h-p power generation without boiler change. Little condensate returns from process; heat from blowdown and contaminated process returns is recovered before water is wasted. Demand for l-p steam always exceeds available exhaust; reducing valve operates continuously.



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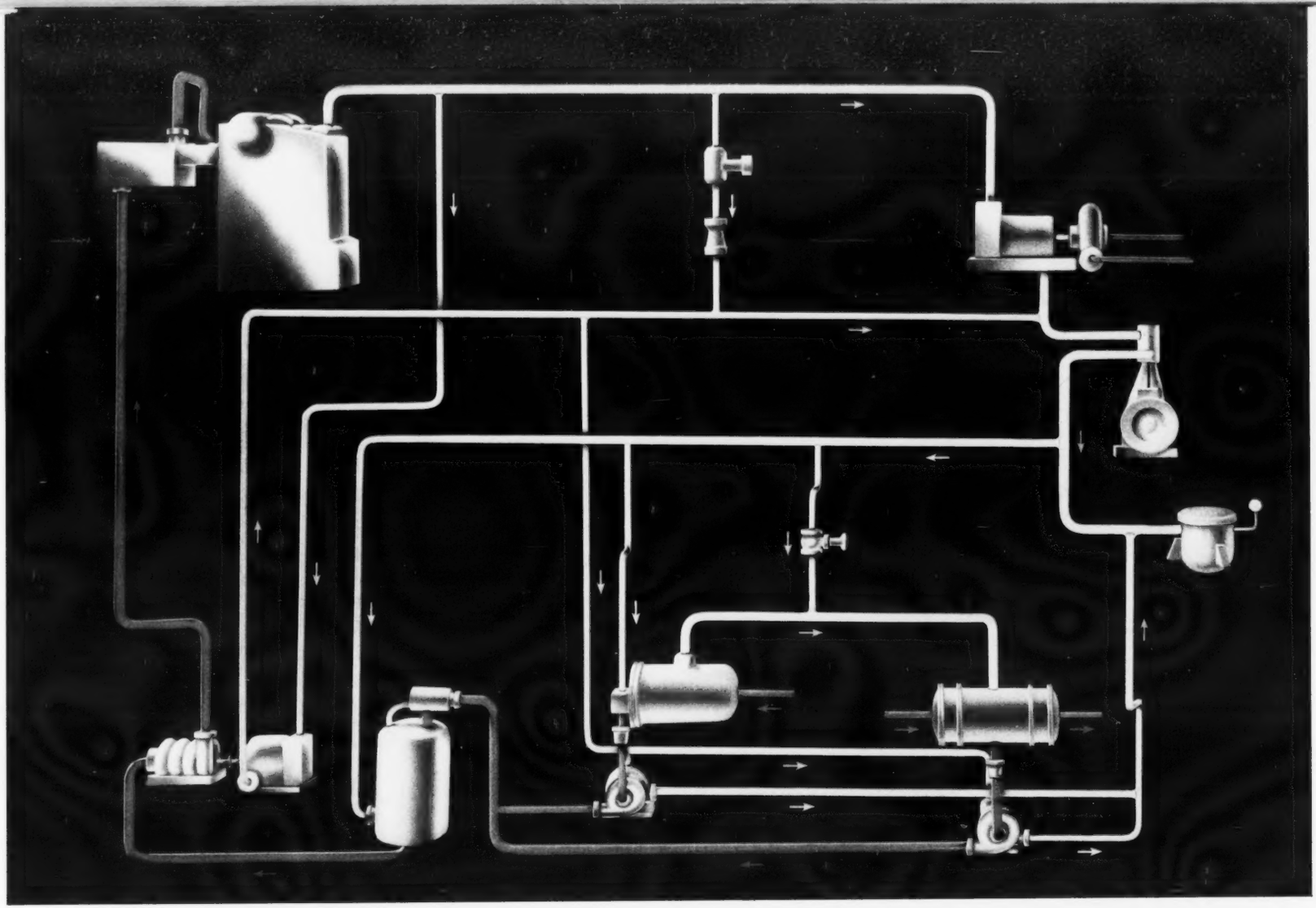
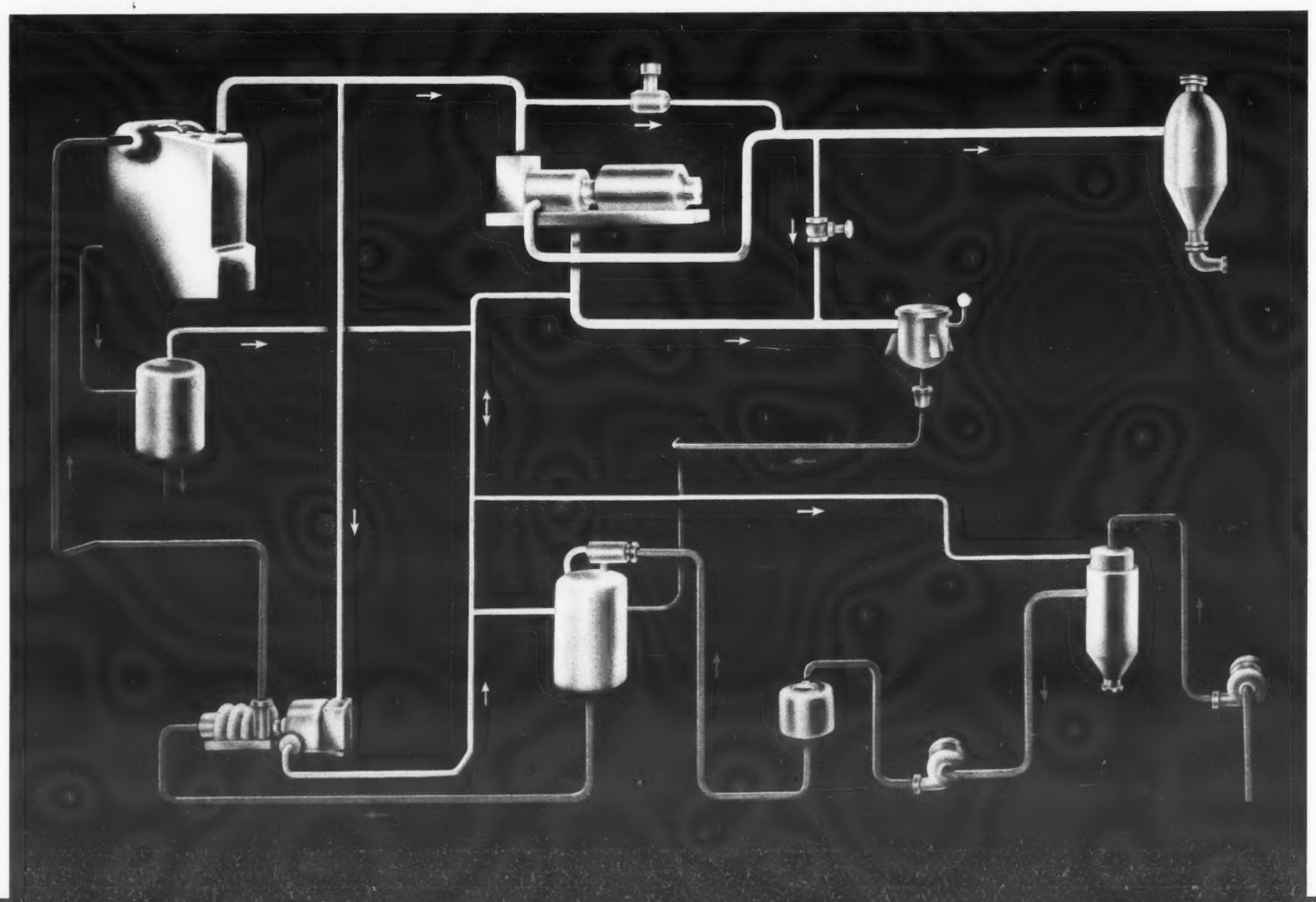


INDUSTRIAL 2 Transmitting h-p steam to equipment drives that act as reducing valves, thereby furnishing l-p steam to adjacent processes, proves most economical in this oil refinery. Turbines driving large pumps exhaust at intermediate pressure to engine drives and process; additional i-p steam is supplied by auxiliaries and a reducing valve. Low-pressure exhaust supplies process, deaerating heaters and evaporators. Evaporator steam and excess l-p steam are condensed for makeup.

INDUSTRIAL 3 In this chemical plant, power needs are small compared to steam demands; a backpressure turbine with bleed point makes low-cost byproduct power and supplies steam for process at two pressure levels. Reducing valves insure steam supply in event of turbine outage. Little condensate returns from process; high makeup requires feedwater treatment, in this case a hot-process softener, filter and deaerating heater. Steam-driven auxiliaries supply exhaust for feed heating.



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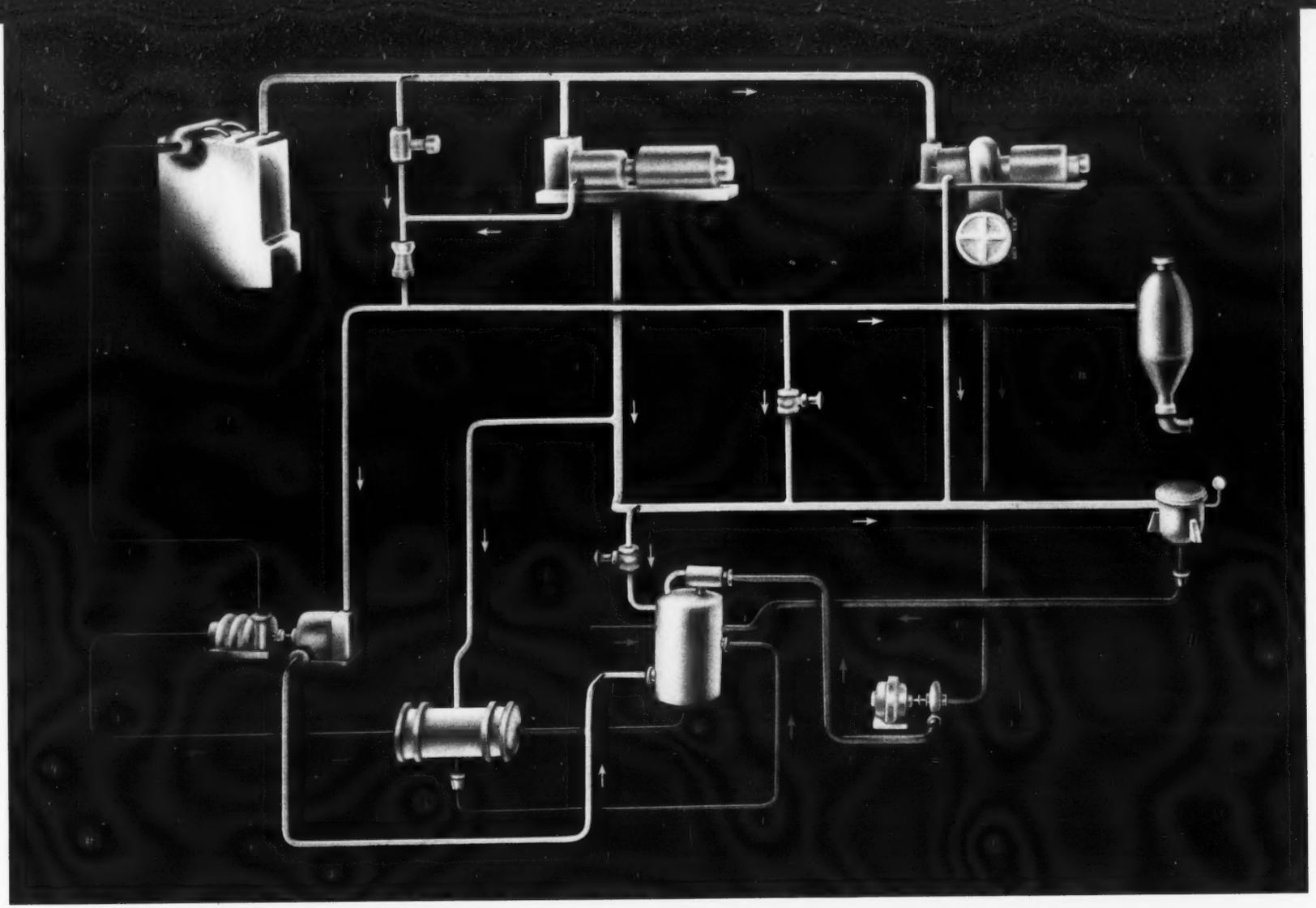
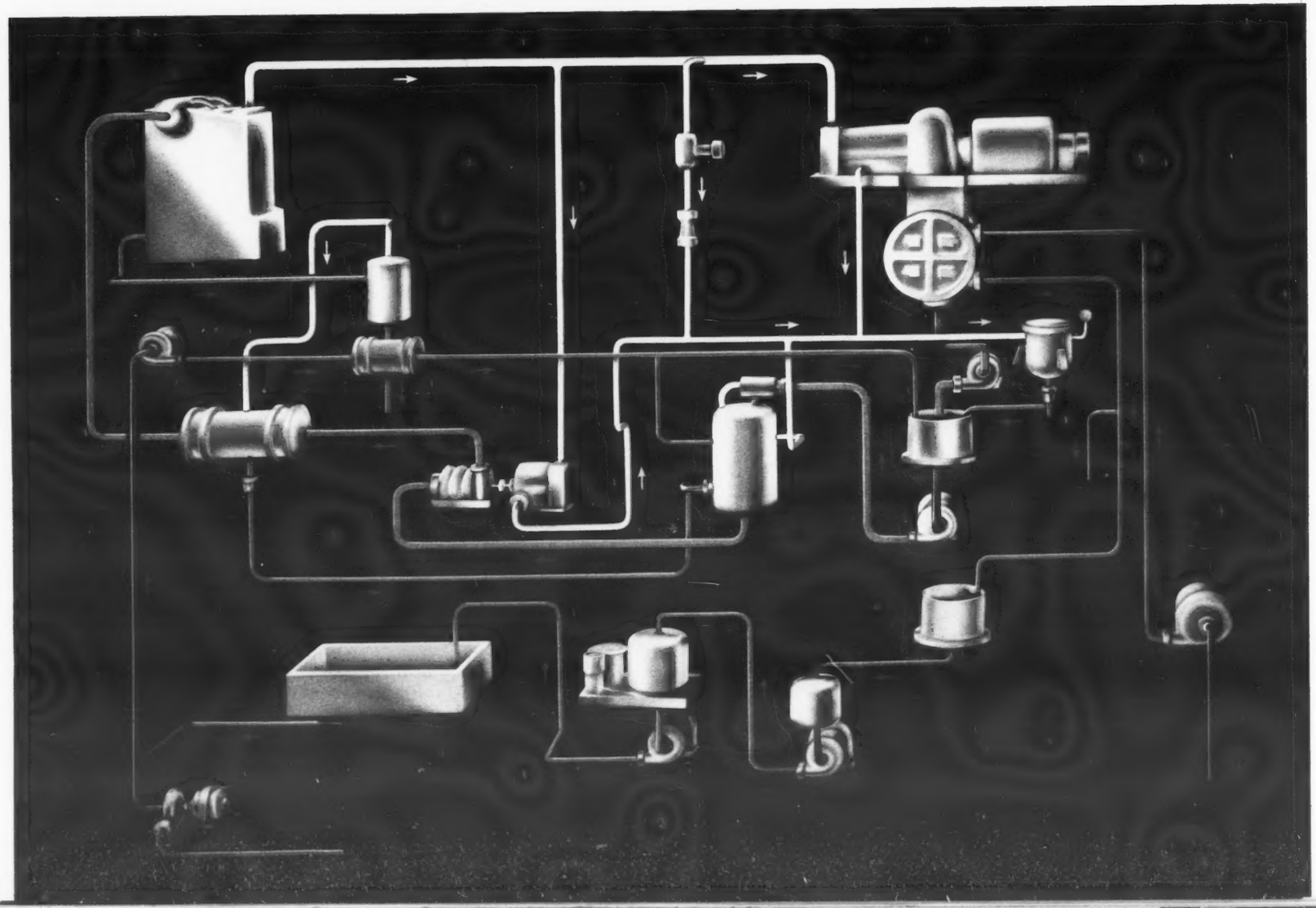


INDUSTRIAL 4 To balance a heavy l-p process load and a smaller demand for h-p steam, power is generated in this paper mill by both condensing and backpressure turbines. Backpressure-unit bleed supplies h-p process; exhaust combines with bleed from condensing turbine to serve l-p process. Flexibility is supplemented by reducing stations between pressure levels and by combining steam- and motor-driven auxiliaries. Additional steam for open heater comes from reducing valve.

INDUSTRIAL 5 Heavy power load, and process demand for large quantities of hot water, influenced layout of this textile plant. Condensing turbine supplies power, with condenser acting as water heater; high vacuum is secondary. Warmed water is filtered and zeolite softened; storage pond absorbs unbalances. Most of water goes to mill, but some is further heated by blowdown for makeup. Auxiliary exhaust, bleed and reducing valve combine to supply l-p process.



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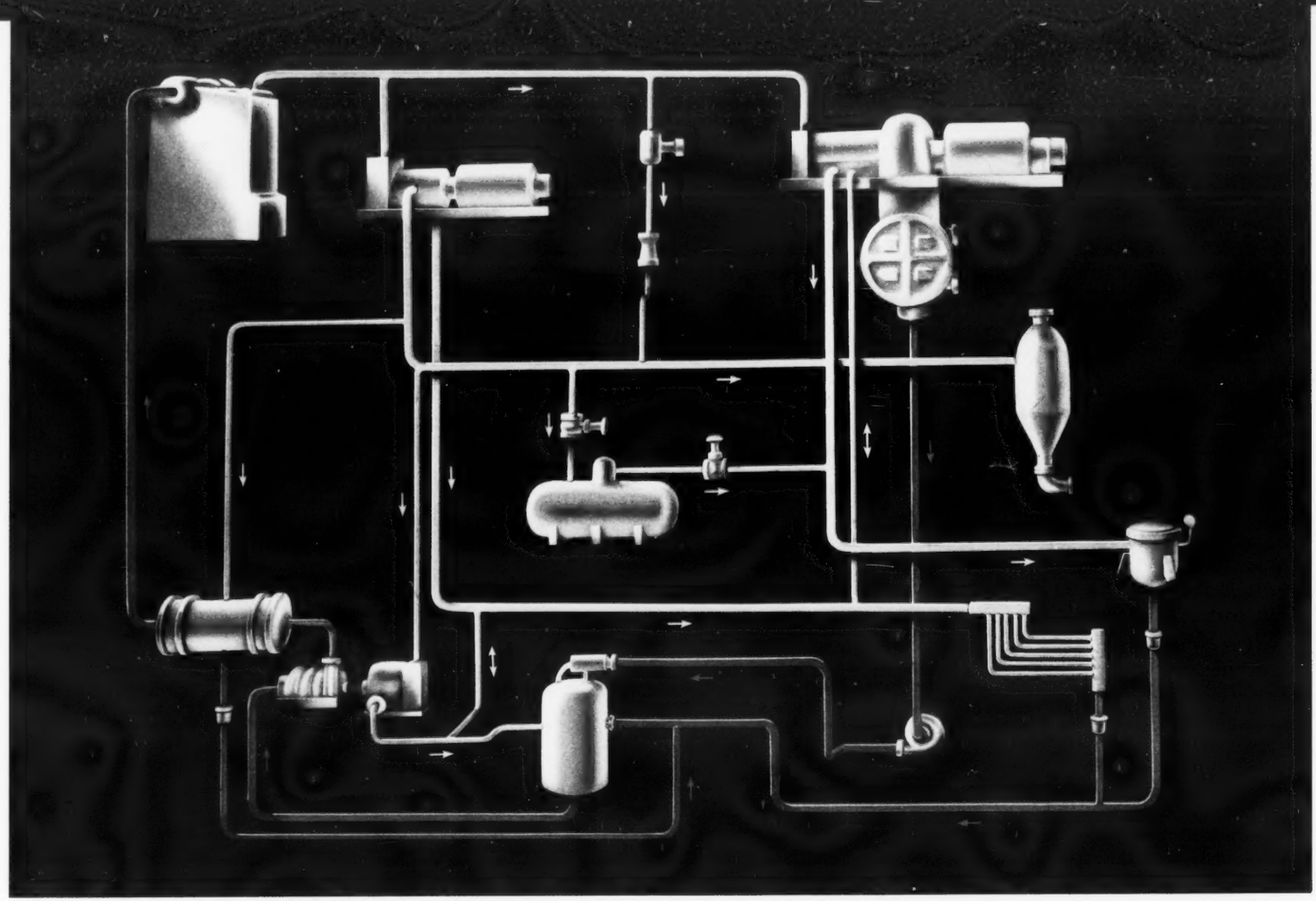
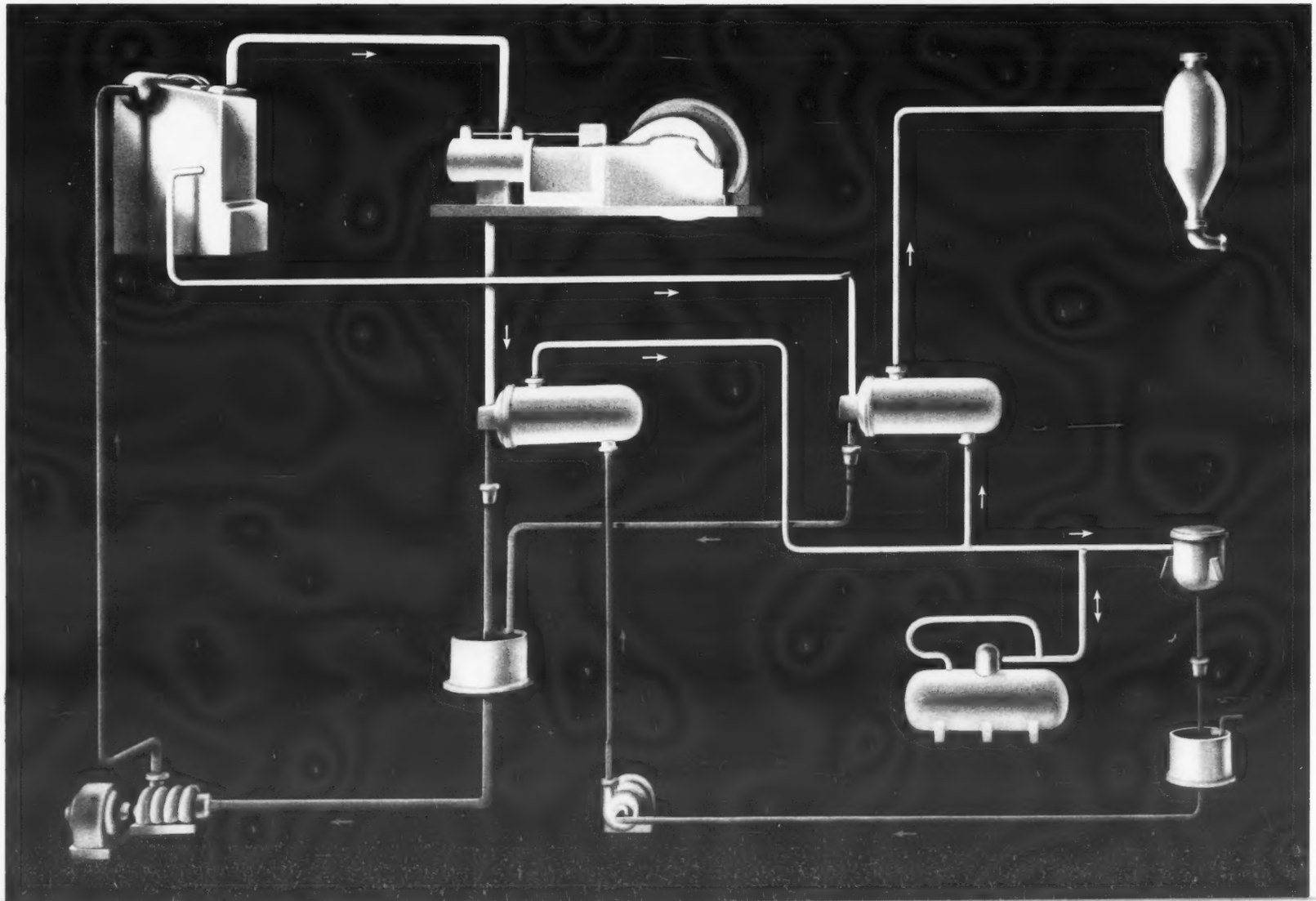


INDUSTRIAL 6 A condensing mixed-pressure turbine and a back-pressure unit, both with extraction, supply this brewery's three process levels. Accumulator irons out swings in intermediate-pressure system at slight loss in availability of steam. High-pressure bleed line supplies accumulator, pressure in which varies widely to obtain large heat storage. Mixed-pressure turbine is designed to take in or extract l-p steam according to balance between steam and process requirements.

INDUSTRIAL 7 Ingenious use of steam transformers results in closed boiler-water circuit in this high-pressure engine plant. Engine exhaust evaporates condensate returns and makeup, supplying l-p process. In a second transformer, saturated steam taken from the boiler by a separate connection superheats steam for high-temperature process. Drains are trapped back to boiler circuit. Accumulator (actually old boilers, not fired) smooths out swinging process load.



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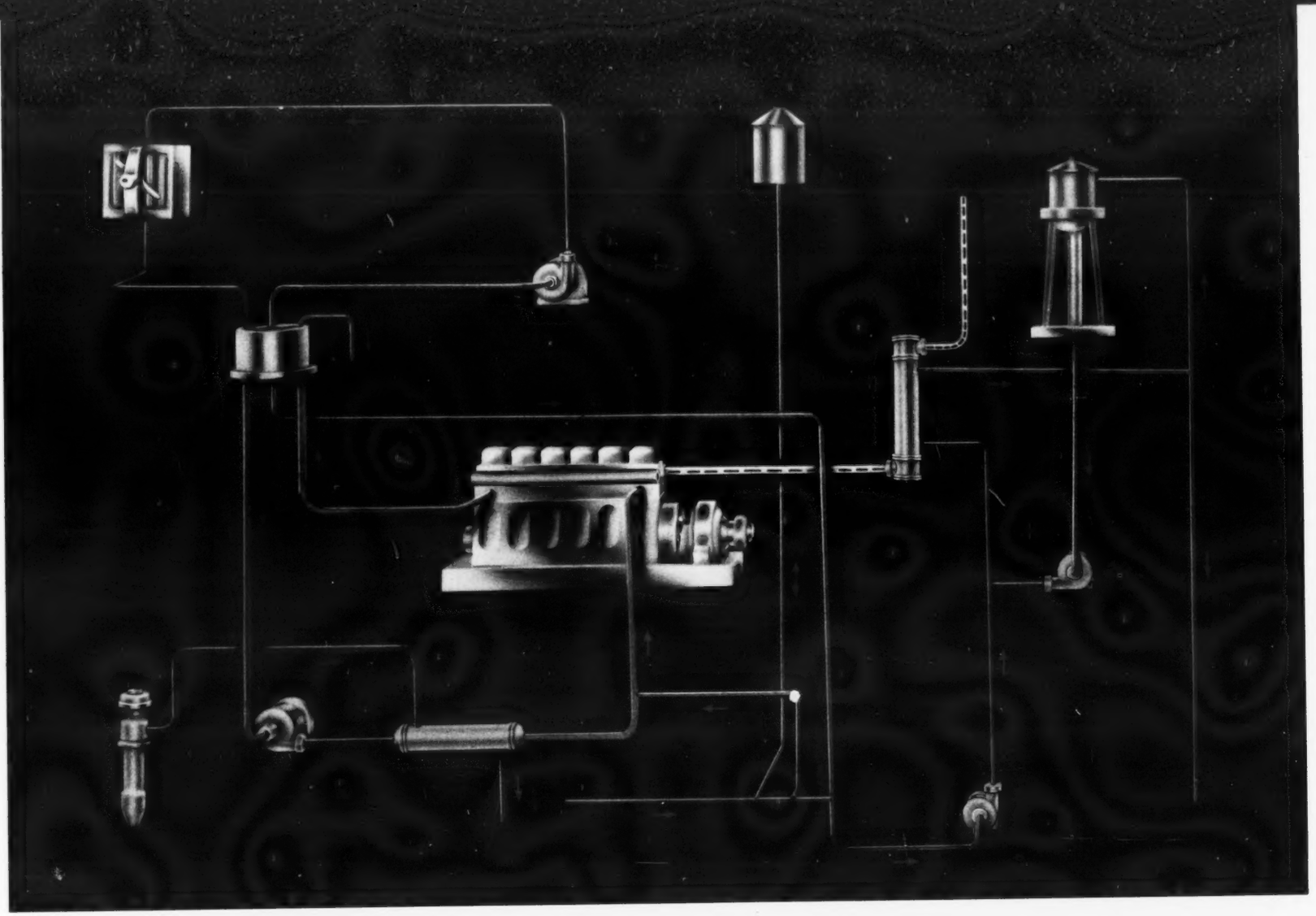
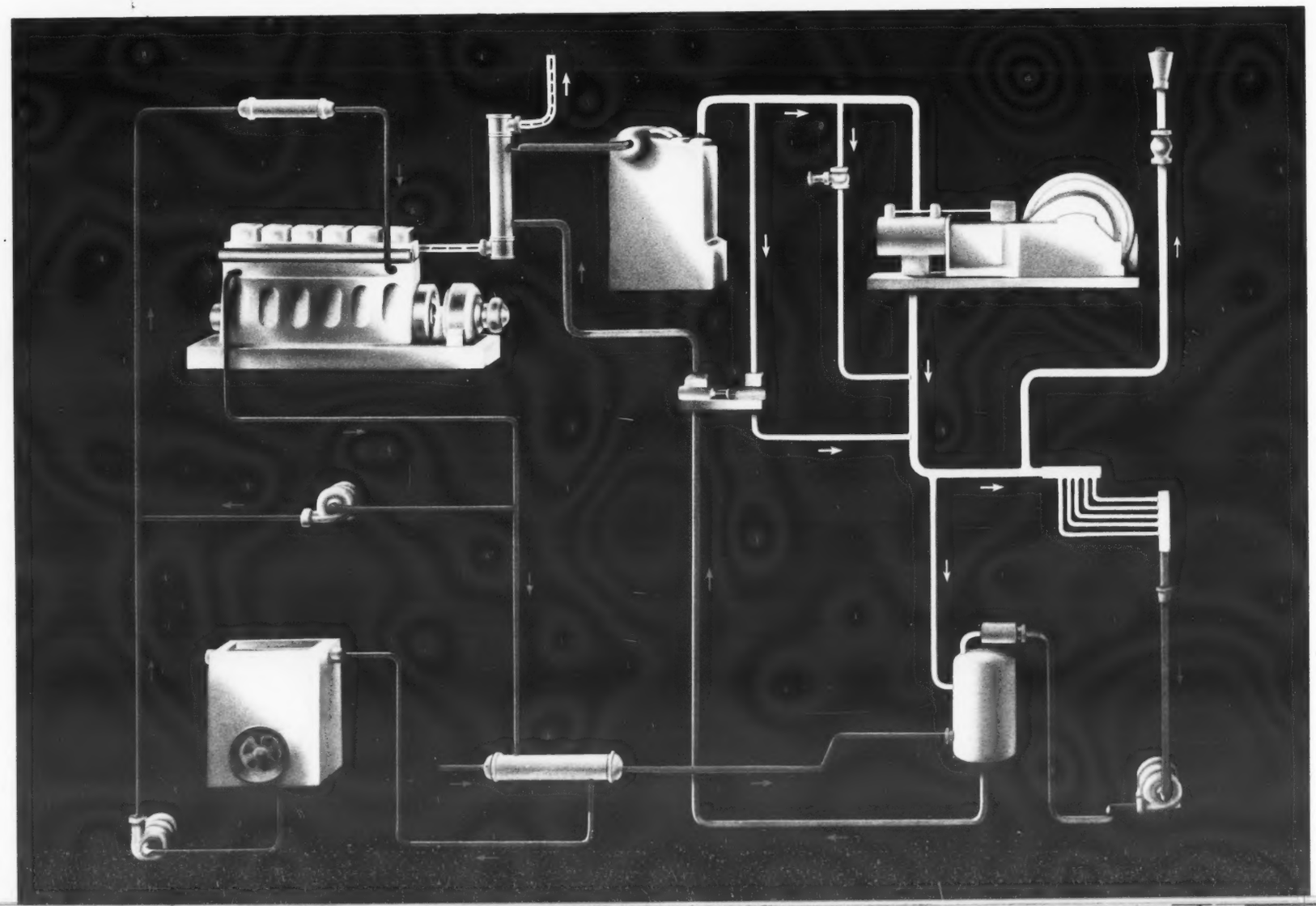


INDUSTRIAL 8 Principal need of department-store plant is power in limited space. Diesel often fits this application. Here, cooling water comes from drilled well and high hardness requires double circuit. Low-head waste heat from jacket water supplies part of building-heating load. Part of jacket water is further heated by exhaust gas for hot-water supply; circulating pump prevents operating heater dry. Flow in all circuits is under automatic control for both temperature and pressure.

INDUSTRIAL 9 Diesel-steam combination is operated to match power and steam requirements closely in this office building. Steam-engine and auxiliary exhaust supplies vacuum heating system. Diesel jacket water heats makeup and temperature of feed is given final boost by exhaust-gas heater. Indoor tower cools jacket water under control of thermostatic valve which divides flow between two circuits shown. Load is shifted from steam to diesel to avoid blowing steam to atmosphere.



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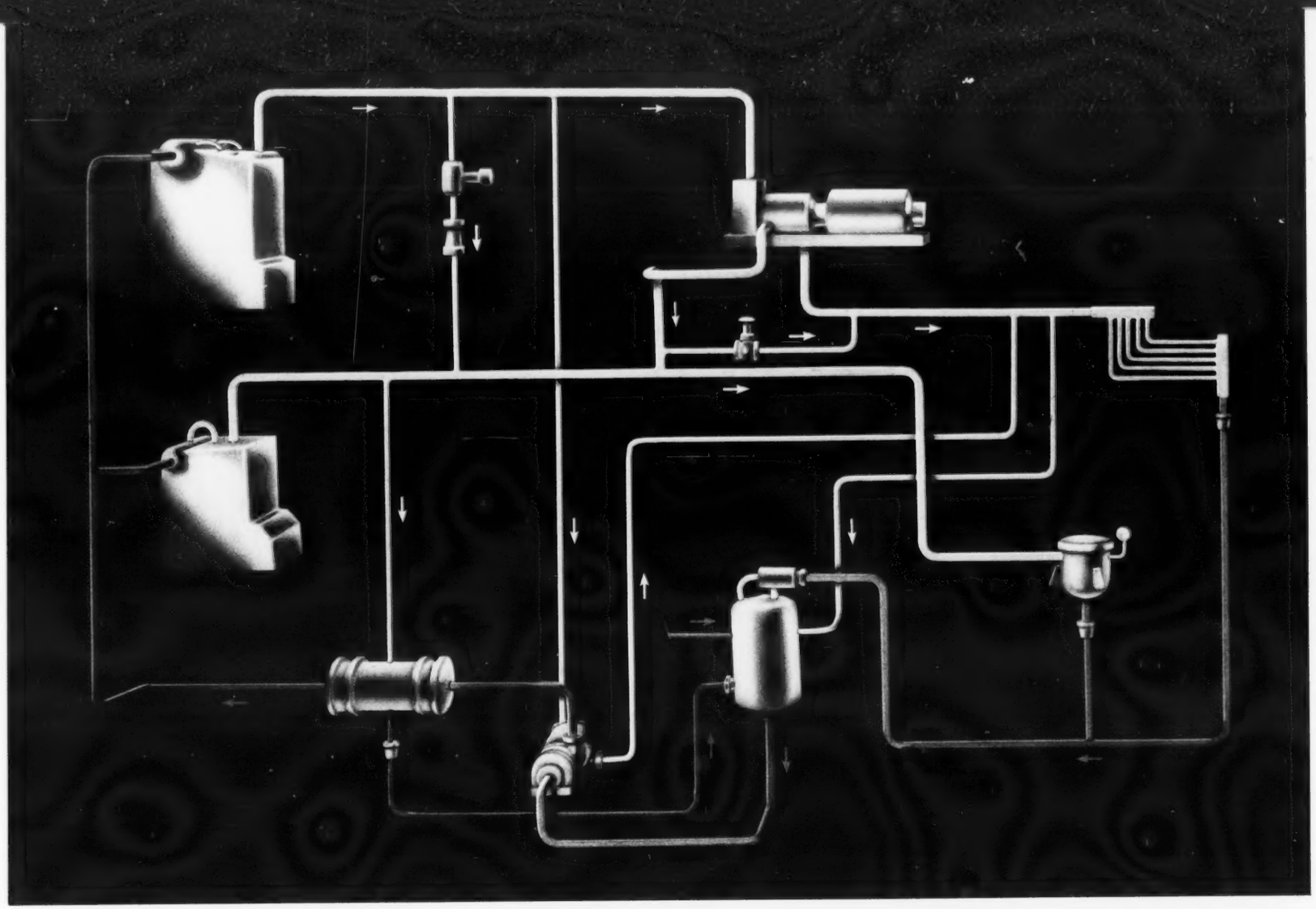
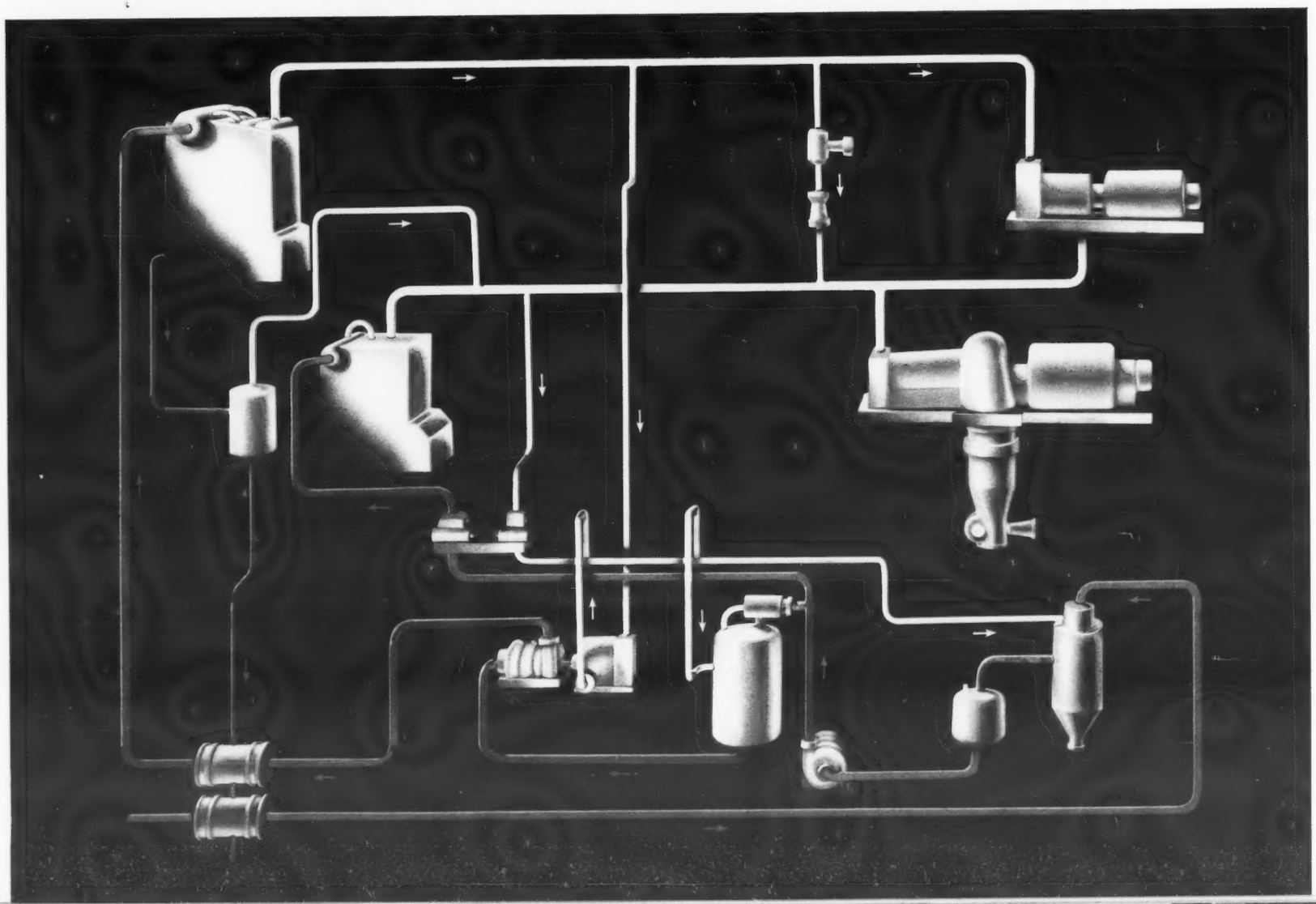


INDUSTRIAL 10 Large steam needs for cooking, laundry and heating, typical of institutions, determine this hospital hookup. Original plant supplied only steam; high-pressure boilers and an extraction back-pressure turbine now meet power load while supplying process steam at two pressure levels. Reducing valves tie pressure levels together; steam-driven auxiliaries exhaust to l-p header. Old boilers are operated during heating season to meet increased steam demand.

INDUSTRIAL 11 Modern steel mills use large quantities of power, little process steam, so plant hookups resemble central stations. Low-pressure turbines with barometric condensers supplied this mill; plant is now modernized by high-pressure boilers and topping turbine. High pressure and 100% makeup demand effective feed treatment; hot-process lime-soda with metaphosphate added at feed-pump suction suit this case. Steam washer in boiler drum completes arrangement.



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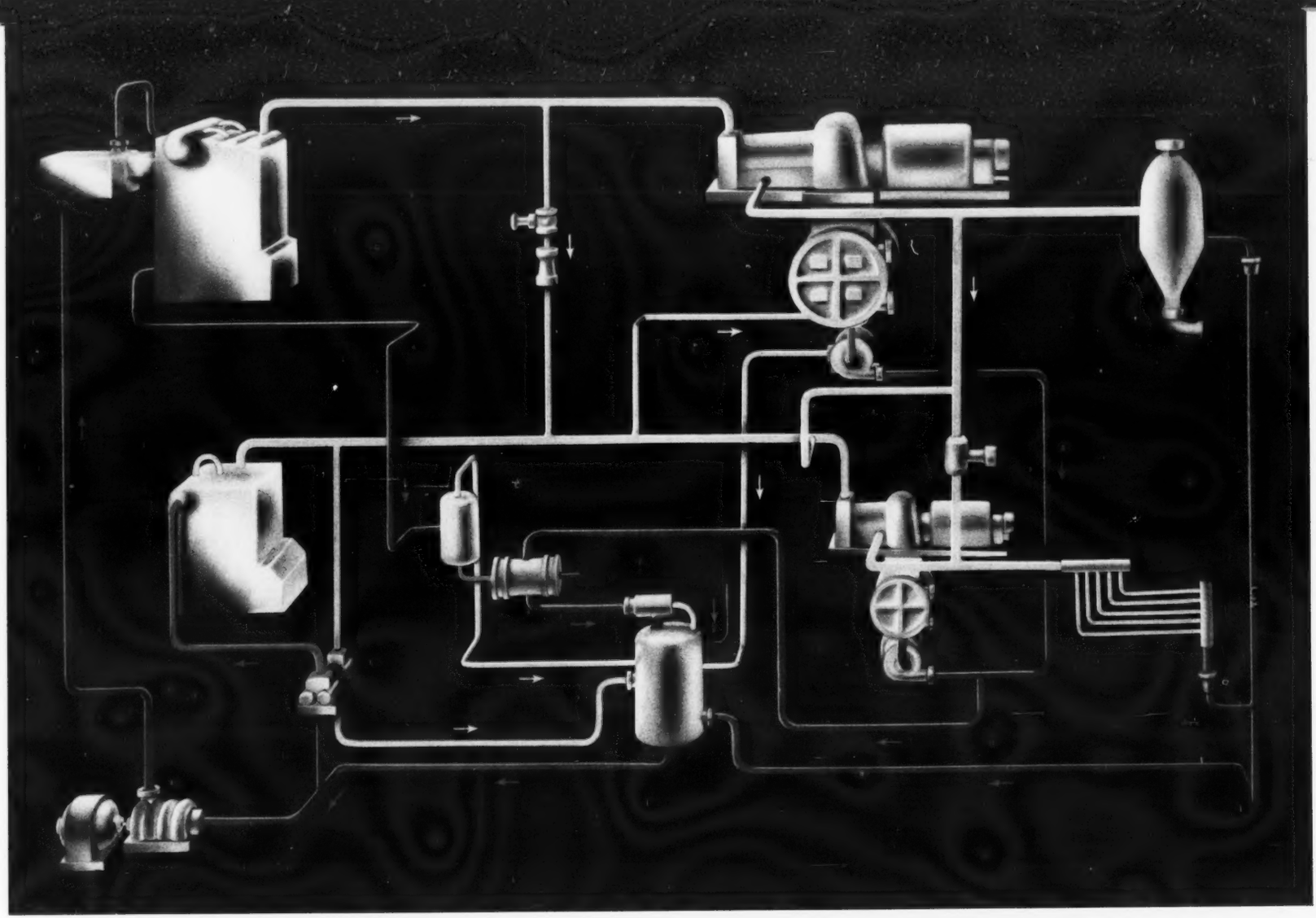
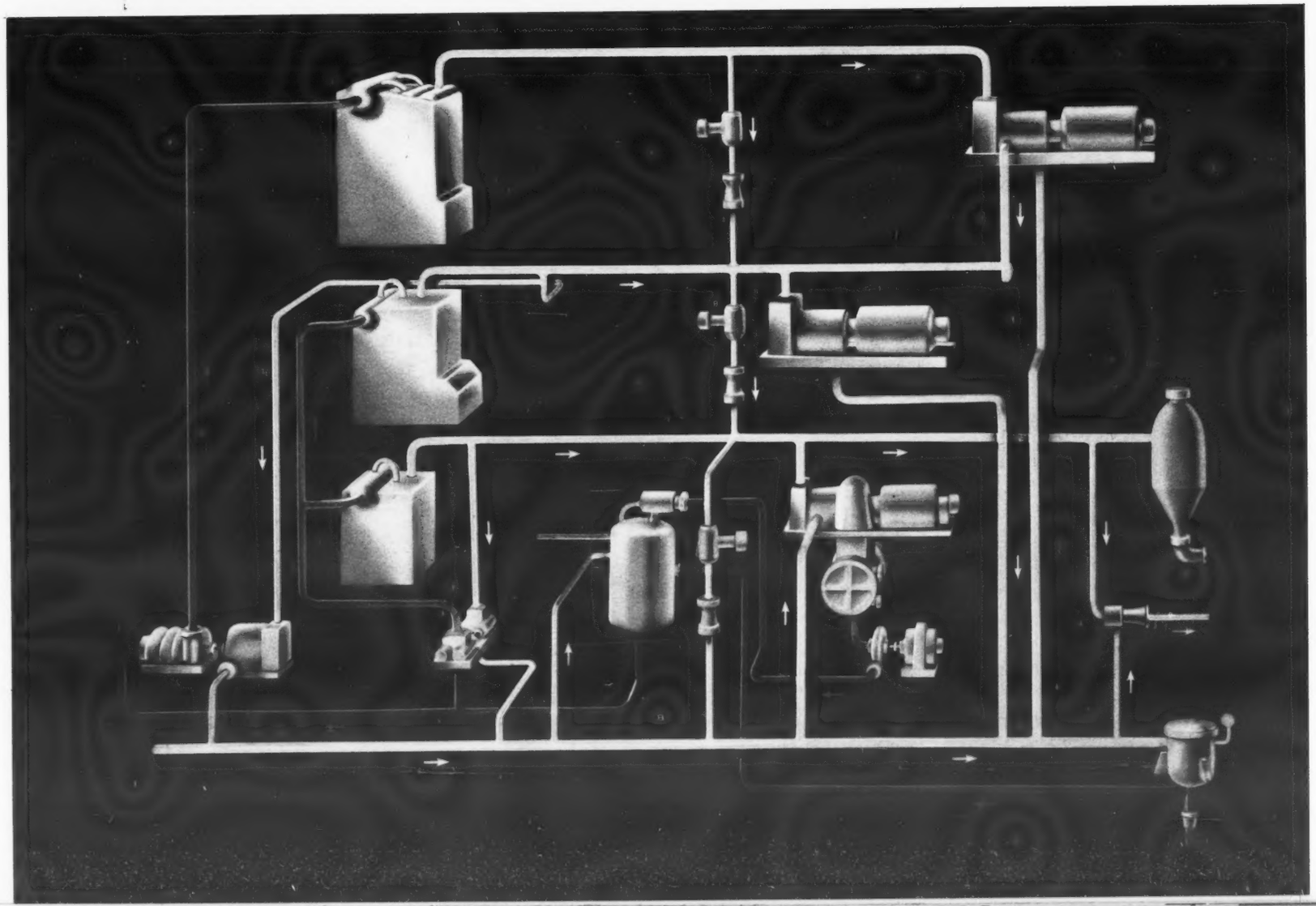


INDUSTRIAL 12 This high-pressure condensing turbine with bleed at former boiler-process pressure illustrates a useful variation of the standard top. Bleed steam supplies existing turbine as well as high-pressure manufacturing process. Low-pressure process is fed from bleed point of old turbine supplemented by reducing valve from new-turbine bleed line. Combination of steam- and motor-driven auxiliaries allows flexible supply to open heater, which also receives blowdown flash.

INDUSTRIAL 13 Successive modernization programs produced this 3-level plant with turbines taking steam at each level. All exhaust goes to l-p process. Newest turbine operates at nearly full load; load on other backpressure unit is determined by process demand. Further balancing of steam and power loads is effected by mixed-pressure condensing turbine. Small amount of process steam at special pressure is supplied by thermocompressor, mixing i-p and exhaust steam.



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POSTSCRIPT

AS THE CURTAIN FALLS, the editors of *Power* hope you liked this presentation. They particularly hope you have discovered here a useful and enduring tool for your power-engineering work. That is what they set out to make when they tackled this job a year ago. So, looking ahead to continued application of this hookup handbook, let's conclude with a summary of its meaning and uses.

First, you have noted that the handbook is in three parts: Evolution, Elements, Applications. Using food as an analogy, you might rename these, in order, The Logic of Cooking, The Art of Seasoning, Nineteen Square Meals.

Number One is a complete lesson in hookup logic. It hammers away at first principles. Dedicated exclusively to straight thinking, it makes no allowances for "styles" in engineering – merely shows what must be and why.

"Elements", next in line, deals with the "hookups within hookups", those secondary circuits that greatly affect the final plant, but are not essential parts of the primary heat balance. These are to basic hookups what salt and pepper are to the fish and potatoes of a chowder. Cooling-water circuits, reducing and desuperheating, steam storage and similar subcircuits can be applied in various ways to each basic hookup. Choice will often depend on some local condition of water supply, process demand or what not. The general rule is "season to taste" after the main ingredients are put together, never forgetting that too much salt, or too little, can ruin the best recipe.

"Evolution" plus "Elements" may be looked upon as an academic course in hookups. The next step is to get practical experience, so "Applications" rings down the curtain on editorial interpretations and takes the reader directly into the field to see what's what. This concluding section presents nineteen hookups that were built into actual plants – nineteen modern solutions of nineteen practical problems by nineteen good engineers. A while back we rechristened this "Nineteen Square Meals." It's just that – something to sink your teeth into after the lectures on cookery.

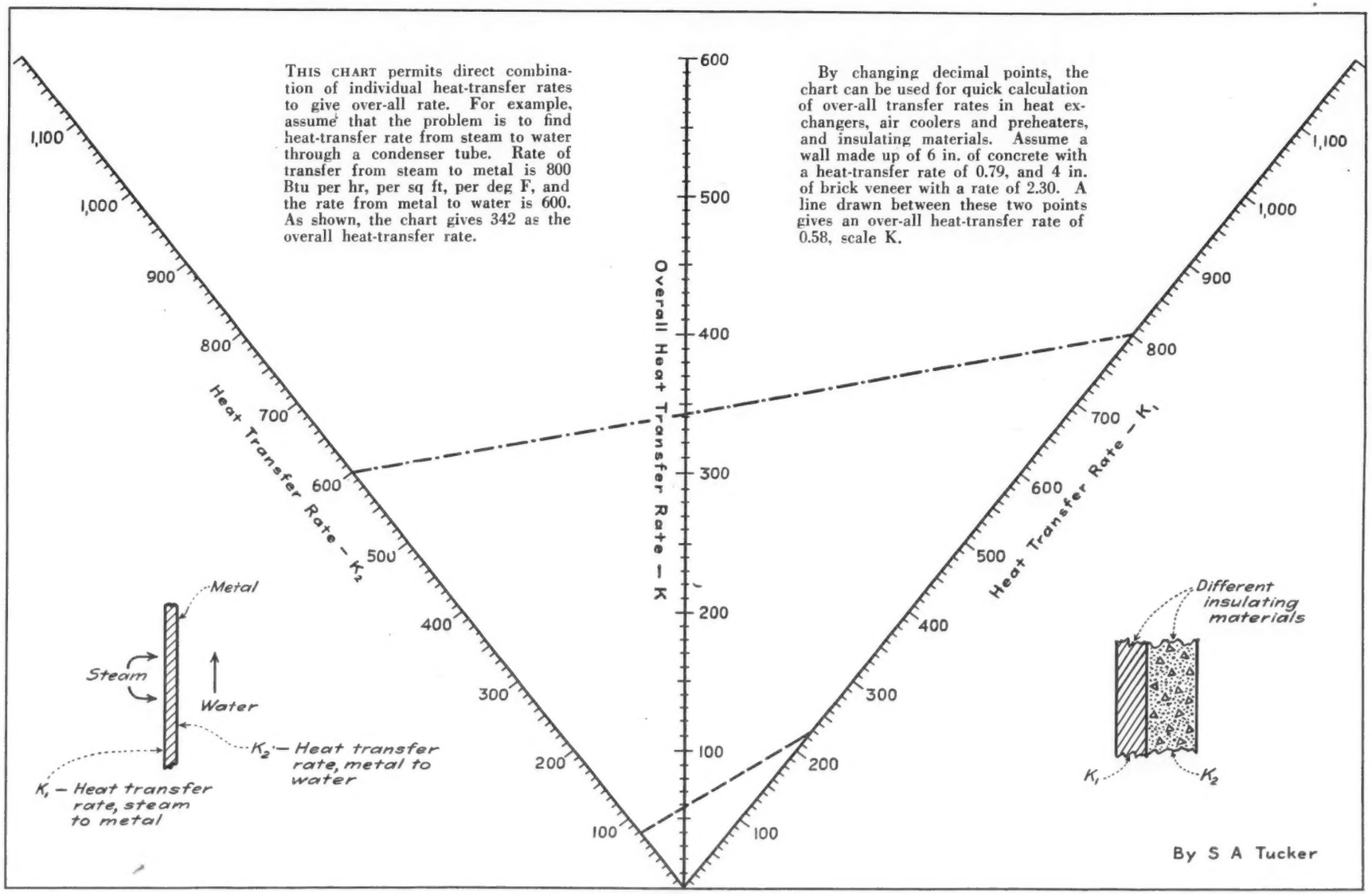
Speaking of this entire handbook of hookups, the editors claim no engineering originality – no additions to the sum-total of human knowledge. This is merely another editorial job of picking and packaging the ideas and achievements of other men.

What we have done, we feel, is to pioneer the application of a new editorial technique for conveying information with greater speed and certainty. We have built a new engineering language out of thirty pounds of catalin, several hundred feet of duralumin rod and a couple of thousand man-hours of model making.

Some engineer may look through these hookups and say they are too simple. We may then properly ask him, in turn, "What basic arrangement has been omitted? What important use or practice has been overlooked? Can you name any plant function so complex that it is not found here in its simple essence?"

It is perhaps unnecessary to note again that hookups are not piping layouts – that this handbook will not solve your problems of equipment selection or of actual physical connection. For that you must serve your years in plants and design offices; must sharpen pencils, push slide rules, wear out shoe leather in plant inspections, suffer the griefs of operation, absorb the specialized knowledge of equipment manufacturers. This book is not design, but the hookup foundation of design.

Over-all Heat-Transfer Rate


THIS CHART permits direct combination of individual heat-transfer rates to give over-all rate. For example, assume that the problem is to find heat-transfer rate from steam to water through a condenser tube. Rate of transfer from steam to metal is 800 Btu per hr, per sq ft, per deg F, and the rate from metal to water is 600. As shown, the chart gives 342 as the overall heat-transfer rate.
By changing decimal points, the chart can be used for quick calculation of over-all transfer rates in heat exchangers, air coolers and preheaters, and insulating materials. Assume a wall made up of 6 in. of concrete with a heat-transfer rate of 0.79, and 4 in. of brick veneer with a rate of 2.30. A line drawn between these two points gives an over-all heat-transfer rate of 0.58, scale K.
Overall Heat Transfer Rate — K
Heat Transfer Rate — K2
Heat Transfer Rate — K1
1,100
1,000
900
800
700
600
500
400
300
200
100
Metal
Steam
Water
K2 — Heat transfer rate, metal to water
K1 — Heat transfer rate, steam to metal
Different insulating materials
K1
K2
By S A Tucker

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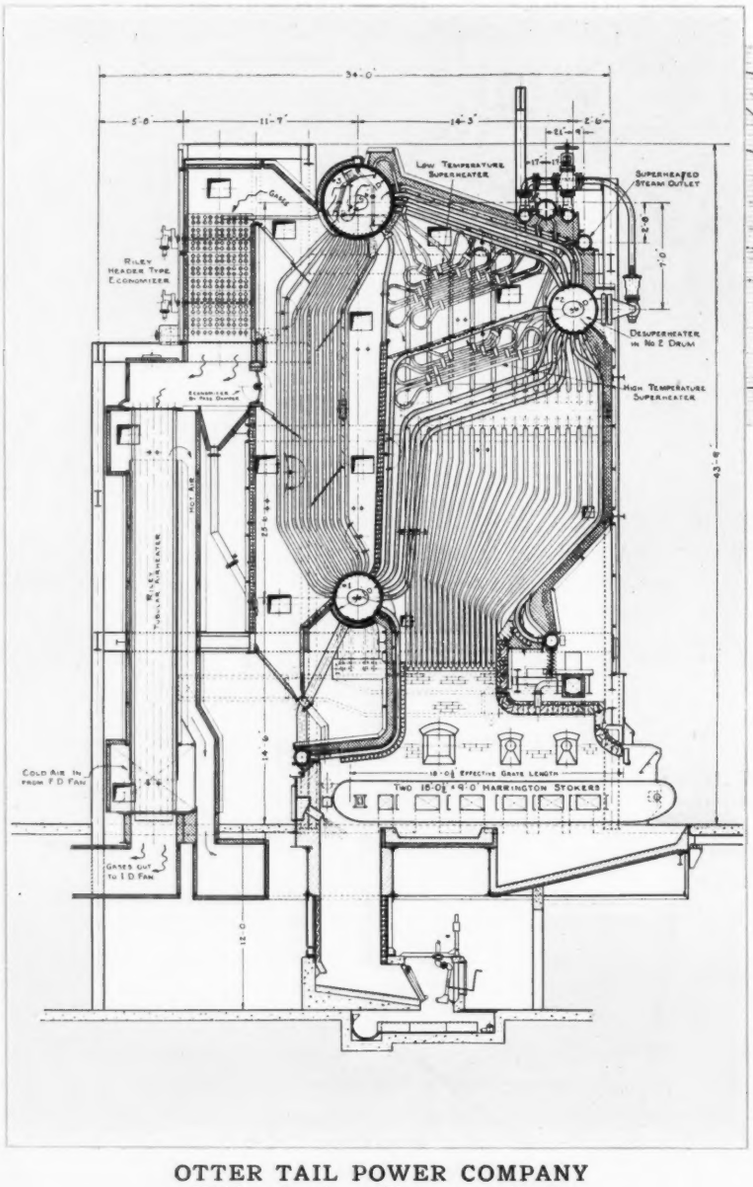
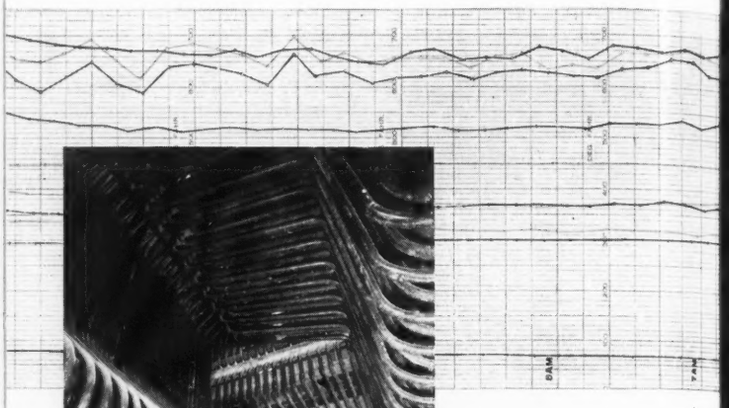
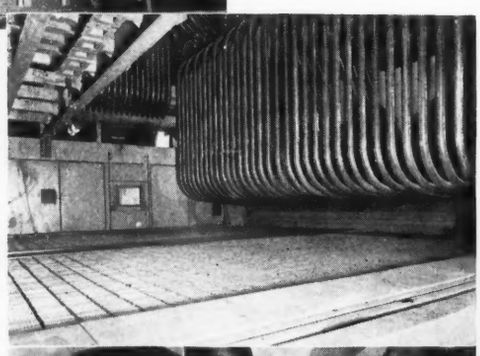
WAHPETON - *the outstanding*

80-82% Efficiency, 300-400% Ratinq

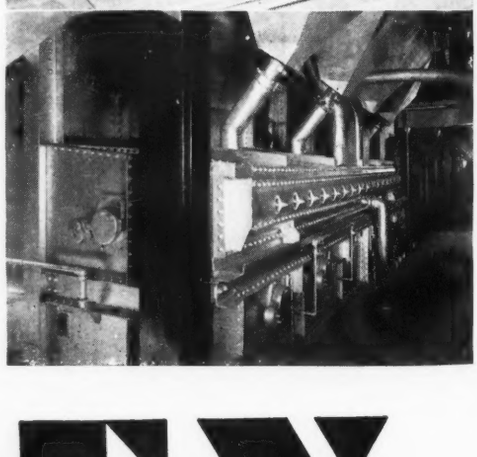

LOW TEMPERATURE SUPERHEATER
SUPERHEATED STEAM OUTLET
RILEY HEADER TYPE ECONOMIZER
DESUPERHEATER IN NO 2 DRUM
HIGH TEMPERATURE SUPERHEATER
TWO 18'-0" x 9'-0" HARRINGTON STOKERS
COLD AIR IN FROM F.D. FAN
GASES OUT TO I.D. FAN



Construction photograph showing water-cooled side walls, water-cooled front wall and front rows of boiler tubes.



Construction photograph showing water-cooled rear arch and Harrington Stoker grate surface.



View of rear of unit at operating floor. Note excellent metal to metal sealing around water wall header.

OTTER TAIL POWER COMPANY
Kidder Station, Wahpeton, N. D.

130,000 lbs./hr.-650 lbs. Design Pressure Riley Unit consisting of Riley Boiler, Superheater, Water-cooled Furnace, Air Heater, Economizer, Steel-clad Setting, Riley Harrington Stoker.

Goeffrey W. Welch, Chief Designing Engineer.
N. O. Jones, Chief Station Engineer

Fuel Economy Engineering Co., St. Paul, Minn., Gen. Con.

TRADE MARK Rx REGISTERED

RILEY

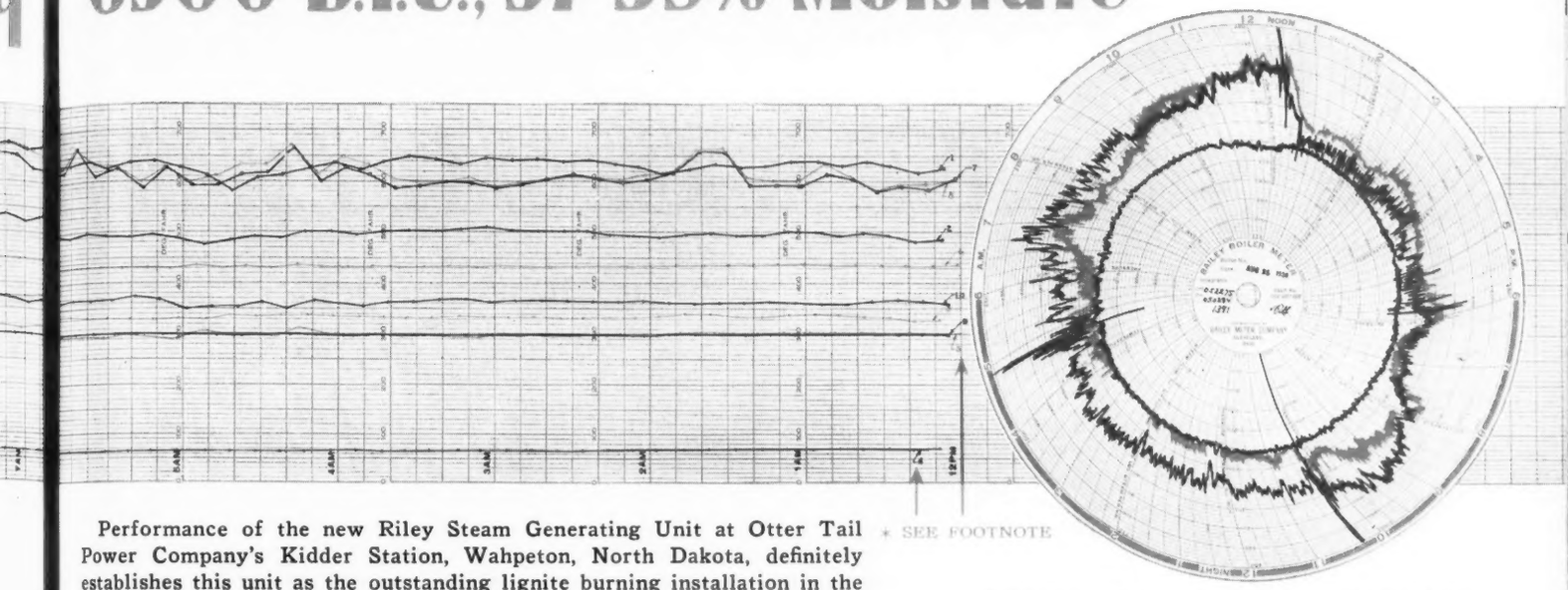
STOKER CORPORATION, WORCESTER, MASS.

Boston New York Philadelphia Pittsburgh Buffalo Cleveland Detroit Tacoma Baltimore Milwaukee Denver
St. Louis Cincinnati Houston Chicago St. Paul Kansas City Los Angeles Atlanta Memphis New Orlean;

It will pay you to visit modern Riley Installations

lignite burninq installation

6300 B.T.U., 37-39% Moisture

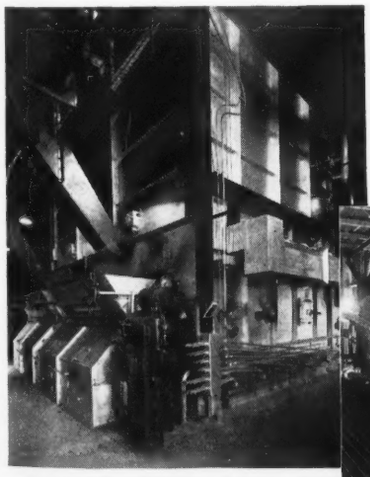


★ SEE FOOTNOTE

Temperature and steam air flow charts showing typical day in and day out performance of the Wahpeton Riley unit.

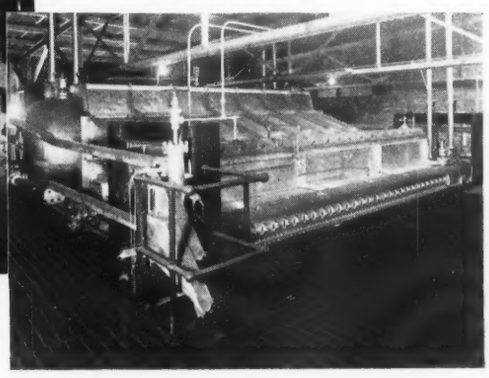
Performance of the new Riley Steam Generating Unit at Otter Tail Power Company's Kidder Station, Wahpeton, North Dakota, definitely establishes this unit as the outstanding lignite burning installation in the United States and Canada. Efficiencies from 80% to 82% when operating at ratings of between 300% and 400% and when burning 6300 B.T.U. lignite containing from 37% to 39% moisture, constitutes performance never before attained in the utilization of these low grade fuels.

It is particularly gratifying that these excellent results are obtained with trouble-free operation, comparatively low auxiliary power consumption and very low maintenance. This outstanding performance is the result of the many years of experience and painstaking development in the design of the leading lignite burning installations in the country.



View of front of unit showing front of Harrington Stoker. Substantial construction of steel casing assures permanently air tight casing.

View of roof casing. Steel casing is designed and constructed to assure air tightness over entire unit.



Mr. G. W. Welch, chief designing engineer of the Otter Tail Power Company, has been intimately associated, from the very first, with the development and progress of lignite burning installations, having designed the Washburn Station of the company, this being the first plant to operate exclusively on North Dakota lignites. Back in 1929, Mr. Welch reported with justifiable pride the operation of the Washburn units at 71% efficiency and ratings up to 250%. The results of the operation of the Wahpeton unit clearly show the steady progress made since that time. Much credit is due him for the tremendous development in the art of lignite burning.

The Riley Stoker Corporation and their St. Paul representatives, The Fuel Economy Engineering Company, have also contributed their share in the development of lignite burning installations. Riley equipment has been installed in practically all of the outstanding lignite burning installations in the Northwest. The Fuel Economy Engineering Company have cooperated in the design and have served as general contractors in connection with many of these installations.

Performance has definitely established the Harrington Stoker as the most satisfactory equipment for economically burning Dakota lignite.

★ Key to lines on chart above

1. Gas temperature leaving boiler
2. Gas temperature leaving economizer
3. Gas temperature leaving airheater
4. Air temperature entering airheater
5. Air temperature leaving airheater
6. Saturated steam temperature No. 3 drum
7. Superheated steam temperature at intermediate header
8. Superheated steam temperature at outlet header
9. Water entering economizer
10. Water leaving economizer

COMPLETE STEAM GENERATING UNITS

BOILERS • PULVERIZERS • BURNERS • STOKERS • SUPERHEATERS • AIR HEATERS

ECONOMIZERS • WATER-COOLED FURNACES • STEEL-CLAD INSULATED SETTINGS • FLUE GAS SCRUBBERS

before purchasing Boiler or Fuel Burning Equipment

★
PUBLIC RELATIONS FOR POWER MEN
★

★ ★ ★ ★ ★ ★ ★ ★ ★ ★

16 STEPS TO CHIEF

Somebody, a long time ago, said: "It isn't the job; it's you!" What, then, are the characteristics you need to be a successful Chief Engineer?

BY E J TANGERMAN
Consulting Editor

MY SON HANNIBAL will be a great general," said Hamilcar, "because of all my soldiers he knows best how to obey." And that son took elephants across the Alps to humble a mighty Rome!

He knew how to obey—today we'd say that he knew how to "take it as well as dish it out." He could lead men because they worked *with* him, not *for* him. He never sent a man to do something that he hadn't done himself, but at the same time he never excused a job half done.

In a power plant, no matter how small, responsibility is no little thing. Consider, if you will, only the job of power supply. There may be a surgeon with knife poised, a mill with a hot slab ready to go through the rolls, a city ready to turn on its evening lights—everything must stop if the power fails. It is the vital necessity of power that requires the chief and his crew to be constantly on the alert. This is their job, and beyond that, their duty.

This responsibility means that the chief first must learn to control himself. If he can learn to do that, control of others below him, or around him, is a simple matter.

In plain English, the title doesn't make a chief. In addition to technical and practical ability, he must learn understanding of three separate groups —the men who work for him, those who work around him, and those for whom he works. The same qualities make him able to get along with all three, and result in the cooperation, the "gang" spirit if you will, that alone gets real and permanent results. Let's just list those qualities which come to mind:

Fairness. First essential in any chief's make-up is unswerving justice in his dealings. You can't play favorites. Nothing rankles so much with a subordinate or another department chief as the feeling that you've given him a raw deal—and nothing breeds more potential trouble. "Blind mad" is not only apt but accurate.

Knowledge. You must know your plant, the basic principles, and have figured out what to do in time of need. You must also know the major problems of other department chiefs and what you can do to help in their solution. And don't be too proud to ask their help when you need it—or an outside expert's if necessary. Remember the old Chinese proverb, "If you wish to know the road ahead, inquire of those who have traveled it."

Leadership. You are the natural leader of your "gang", unless you fall down on them. As such, they expect you to suggest fair courses of action, both for them and for the Boss. If you fail them, they will choose another leader, maybe of the wild-haired variety, who'll make your department a hotbed of trouble.

Tolerance. You have no right over your men's thinking outside the plant, as long as they do the work they're paid to do. Regardless of your feelings about stamp collectors, butterfly chasers, communism, hikers, or poker players, it's none of your business, unless hobbies or ideas interfere with work. Difference of opinion is healthy, as well as being the principal reason for horse races.

Difference of opinion is healthy, as well as being the main reason for horse races

Moderation. You can't be a good fellow and a good boss. Drink with your men, but not too often or too much. Swear at them and with them, but only when the situation justifies it. Don't fly off the handle and say things you'll be sorry for. And don't be high and mighty—even the Boss of the next department may turn out to be as smart as you are.

Understanding. Learn to distinguish between the good man on an off day and the habitual grouser, between the man with family troubles and the perennial sorehead. If the Boss comes down and gives you hell, remember that his wife may just have given him hell too—or that he's off his golf game. The same thing may be true of the "man next door".

Loyalty. Be loyal to both your men and your management. You are the "go-between", and on your attitude depends the relationship of your department to the rest of the plant. Be

Inquire of those who have traveled

loyal to your men by giving them assurance of reward when merited, of fair and adequate pay as far as you can, reasonable hours, ample safety and security, and a real opportunity for advancement. Be loyal to your management by giving dollar for dollar value, both in your own work and that of the men who work for you. If you like your job, work at it, if you don't like it, quit.

Ideas are more important than servility

Progressiveness. Keep informed on new methods and new materials. It will increase the respect of your men for you and your belief in yourself. If you are a go-getter, your plant will almost invariably show good results, particularly if you are open-minded enough to accept suggestions. Remember that most of the advances in any science have been made by outsiders, and most of the radically new inventions have been made by non-engineers. Ideas are a whale of a lot more important than slavish servility. Encourage them.

Patience. You can't expect every man you hire to know as much, or to think as fast, as you do. And you're probably not a Dale Carnegie in the ability to talk clearly. Take time to be sure that every man understands what you're talking about, and then hold him to it; that avoids the bluff-and-blunder system that spells eventual trouble.

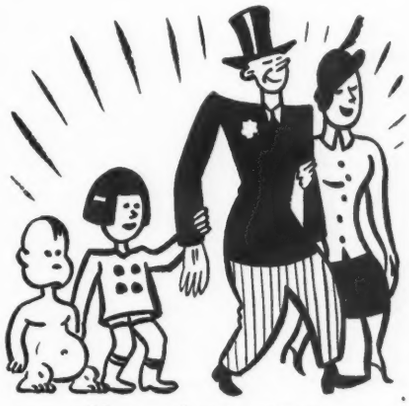
Avoid bluff and blunder

Appreciation. Remember always to give credit where credit is due. A deserved pat on the back takes little time and no effort, but it pays big dividends in loyalty and conscientious subsequent effort. And a little appreciation for outside cooperation makes future getting together much easier.

Interest. Your men, and your Boss, are human. Each is as proud of his rose garden, his new Ford, or his youngest as you are of your new engine model. Their interests may be entirely different from yours, but don't be snobbish. If you're interested in their personal problems, they'll repay you by greater interest in their jobs. Besides, you'll learn of pet peeves—both inside and outside your department—that you can clear up easily before they become major grievances.

Good Housekeeping. Just as dirt breeds dirt, neatness begets neatness. A clean plant builds efficiency and pride in accomplishment, as well as uncovering the little troubles that unattended might grow to shutdown.

System. Keep complete plant records. They will help you judge men fairly, to operate systematically, and to meet criticism without flying off



Neatness begets neatness

the handle. After all it's pretty hard even for an Einstein to keep on arguing when he sees the figures. And carry system all though the plant. Assign duties equally and see that they're carried out. Keep records yourself and train your men to do so by showing them what good records can do. System leads to economy, and they'll be prouder of a top-ranking plant than a poor one.

Judgment. You probably can't wield a paint brush as well as Bill or a shovel as well as Mike, but you should be able to recognize a good job when you see it and a good man when you meet one. You can't get that kind of background out of books. You'll have to—if you haven't already—take your collar off and try

You can't get that kind of background out of books

to paint and to shovel. Then if Bill asks for a different kind of brush or Mike for a new-fangled shovel, you'll have some real basis for deciding. And what applies to paint brushes applies to turbines. Buy blind and you'll run lame.

Punctuality. Be on time and follow the rules yourself, and you'll have little general trouble with laxity. A power plant must have certain men on duty at certain times; set the example yourself.

Perseverance. Insist on a good job and do one. Remember the old adage, "If at first you don't succeed; try, try again." That means, too, that you don't start repainting by kicking over the old bucket.

It's obvious that no man can be all these things, and still be human. But they're something to shoot at, something to try for. We both know that the thing that makes games so interesting, as well as so much fun, is the "gang" spirit they create. Take that away and the whole performance becomes work. The same thing holds true in a power plant. If each man feels himself an essential cog in the scheme of things, he'll work harder to do his pushing each time it's his turn. And when every cog takes its load, you get a smooth-running machine that carries its responsibility.

Don't start repainting by kicking over the old bucket

Latest Developments of the Benson Boiler

The Benson boiler was first publicized in 1923 as a way to generate steam at critical pressure, 3200 lb. There are now 82 installations in Europe, mostly recent. Pressures range from 1000 to 2500 lb. and many plants operate on "floating-pressure" system

By FRANCIS HODGKINSON *

THIS PAPER is principally a report of recent developments of the Benson boiler in Germany, but the author first reviews earlier history.

In 1923 the English Electric Co, Rugby, England, built a boiler designed by Mark Benson. Shortly thereafter, all further development work was undertaken by the Siemens-Schuckert Werke (S S W) in Berlin, Germany. (*Power* on May 22 and 29, 1923, devoted 11 pages to the first articles published on the Benson boiler. Through these, S S W first learned of the Benson experiments).

In those days it was assumed that a "once-through" boiler must operate at least with critical pressure (3200 lb for steam) to assure stability. Steam so generated was at first throttled to some lower pressure (1500 to 2500 lb).

Development in America

Following studies made by the author and others, Westinghouse Elect & Mfg Co acquired an exclusive license in 1933. At that time it had been shown that critical-pressure operation was not imperative—that the Benson boiler could operate at any pressure above 500 lb. The Germans developed a system of variable-pressure operation, pressure being varied in response to turbine-load.

Engineers recognized that this boiler offered cost reductions at higher pressures, because it had no drums and could operate at higher pressures than could boilers dependent upon convection currents for circulation and upon drums for the separation of steam from water. It also offered greater safety. On the other hand, there was no reason to expect any gain in steam-generating efficiency over conventional boilers.

Operation with variable pressure made turbine simpler and less costly. Except for an overspeed emergency governor, the turbine required no valve gear controlling steam flow, although it might be necessary, on the other hand, to control boiler feed and combustion from turbine speed.

In particular, this method of operation eliminated need for complex and costly automatic means of cutting nozzles in and out with load variation. Thus the turbine could sustain enormous overloads without requiring any special valve gear or means of by-passing.

Allowing for vacuum variation with load, isentropic heat drop to condenser pressure, and total steam volume, are practically constant down to low loads, with this method of operation. Thus turbine proportions are appropriate for any output and the turbine efficiency practically constant.

Westinghouse made several tentative proposals, including detailed designs and estimates for a complete superposed plant. These indicated complete justification for the investment and the Benson system seemed the next rational step in power-station economics. That Westinghouse, for good reasons satisfactory to itself, decided, at least temporarily, to abandon development, is beside the point as to its technical value.

The Benson boiler has forced water circulation, and was originally developed to operate at critical temperature, 706 F, and the corresponding pressure, 3200 lb. In essence, it is a heated tube through which water is forced while being evaporated and superheated. It was the idea of Mark Benson, the inventor, to produce steam without boiling, and without any sudden increase in volume, thereby eliminating boiler drums normally needed to separate steam and water.

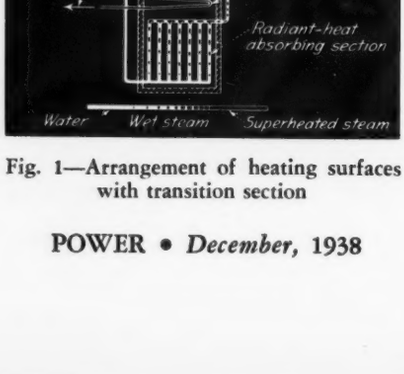


Fig. 1—Arrangement of heating surfaces with transition section

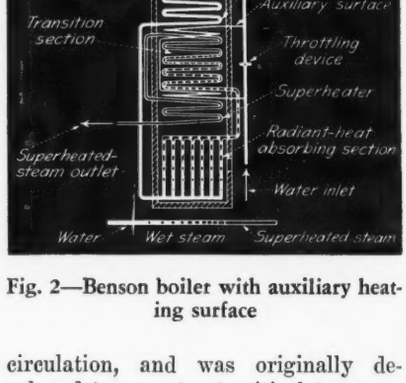


Fig. 2—Benson boiler with auxiliary heating surface

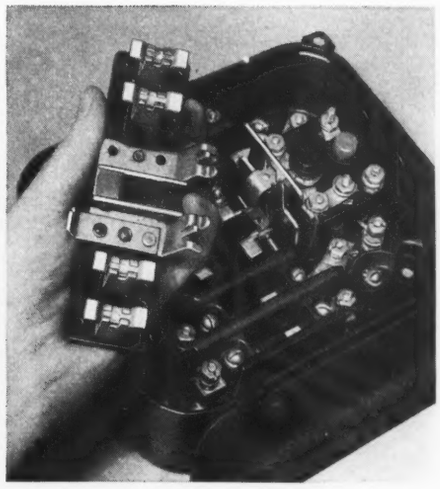
On the other hand, certain unforeseen troubles were encountered in the early large installations at the S S W cable works in Berlin, the Langerbruegge central station in Belgium and on the steamship Uckermark. At the point in the boiler where the steam and water mixture changed to dry-saturated steam, soluble salts were deposited on tube walls. At Berlin and Langerbruegge, this zone of deposit fell in the radiant zone, where tubes were exposed to intense heat. Tube failures occurred after a few days operation.

At first the trouble was difficult to spot, because water circulated during shutting-down washed out the deposits. After the true cause was discovered, the zone of deposit was relocated where gas temperatures were lower so that the scale no longer endangered the tubes. This new arrangement, see Fig. 1, was adopted at the cable works,

* *Abstract of a paper presented before the Power Division of the ASME, October 19, 1938.*

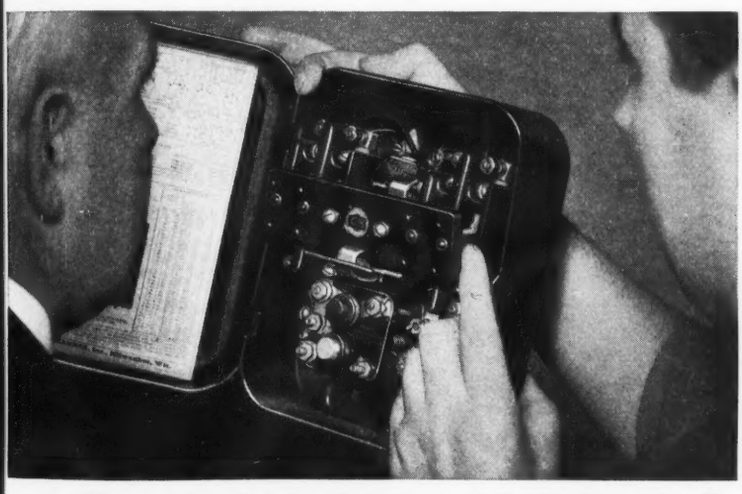
"NOW THE BOSS KNOWS WHY!"

1 "Never mistake size as a measure of importance in Motor Control. The failure of a single small motor of 5 h.p. or less can frequently upset operations and cause big losses. It's just good business to buy the best Motor Control for *any* size motor."



2 "And there certainly is a difference in Motor Control. See how easily this entire contactor unit is removed so the correct magnet coil for any specific job can be inserted or the contacts themselves can be inspected in a jiffy. And these contacts are *solid* silver, believe it or not."

3 "Here's some more *real* design that speaks volumes about the manufacturer's experience. See these pivots or bearings for the moving parts? They prevent sloppy, noisy operation, assure correct alignment of contacts and positive contact pressure. No sliding parts to cause friction, wear, and trouble."



4 "You saw those 'twin-break' silver contacts that break up arcing. Now see how they open . . . *horizontally* . . . so that even the semi-arc produced can automatically lengthen *upward* to carry the heat *away*. It simply licks the problem of burning and pitting of contacts."

5 "And here's the most important part of Motor Control . . . the overload protection. This Cutler-Hammer Eutectic Alloy Relay is the smartest invention of its kind. It keeps the motor working right up to the danger point and *no* farther. It is absolutely dependable, unaffected by dust or temperature changes. No adjustments to make or go out of order. No parts to replace. Easily and simply reset."

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Langerbruegge and on the S S Uckermark.

Thus reconstructed, these boilers have been in satisfactory operation for six years. Salts are flushed out periodically by shutting down for a short period and pumping water through the tube system for about one hour, at a flow corresponding to one-third normal boiler rating. In plants using condensate for feed and distilled makeup, one flushing in three months is ample. Moreover, the boiler is automatically flushed to some extent by forced flow of water in the processes of starting up or shutting down. It would be possible to provide an arrangement for flushing during operation, but this has not been found necessary.

Feedwater Quality

German engineers feel that boilers of all types (including those with drums), should be fed with condensate exclusively, to prevent salt deposits in turbines. Where steam goes to process or where, for other reasons, condensate is impure or only partly returned, German practice employs evaporators hooked up as "steam transformers." Condensed steam from evaporators returns to the boiler. Vapor goes to process. (A similar evaporator arrangement is used in the American plants of Firestone and Ford—Editor.)

With pressures of 1200 lb and up, troubles have been experienced with salts from drum-type boilers choking turbine-blade passages. At high pressures, steam and water differ less in density, and hence separate with greater difficulty. This situation has been greatly improved by installing steam washers in the drum.

Deposits Soluble

Similar difficulties have been experienced with Benson boilers, but only where raw water has inadvertently leaked into the system. Nonadhesive salts generally deposit on the tubes along with adhesive salts. Both can be removed together by flushing. If any insoluble salts are deposited, they can be washed away by a weak solution of hydrochloric acid without injury to tubes. The original S S W boiler, and the one at Langerbruegge, have each been so treated once in the past six years.

Proportioning of superheater surface is no problem. Feedwater is supplied in response to load demand and then fuel in response to steam-temperature indication. This insures desired steam temperature, except where conditions are changing rapidly. (It takes from one to several minutes for water to pass through the boiler.)

To provide sensitive momentary control, an auxiliary tube (about 1/1000 of total boiler-heating surface—Fig. 2) is installed. Water passed through it at high velocity is heated but not evaporated. Since this water flow is proportional to total volume of water, its temperature rise is a direct measure of the heat added to the main flow in the boiler. Regulating for constant heat supply to the auxiliary tube insures constant steam temperature. This regulation, however, is merely a corrective suplement to the normal load-control of feedwater, fuel supply and air in their proper proportions. The auxiliary heating tube is now furnished with all Benson boilers and has operated satisfactorily in every case.

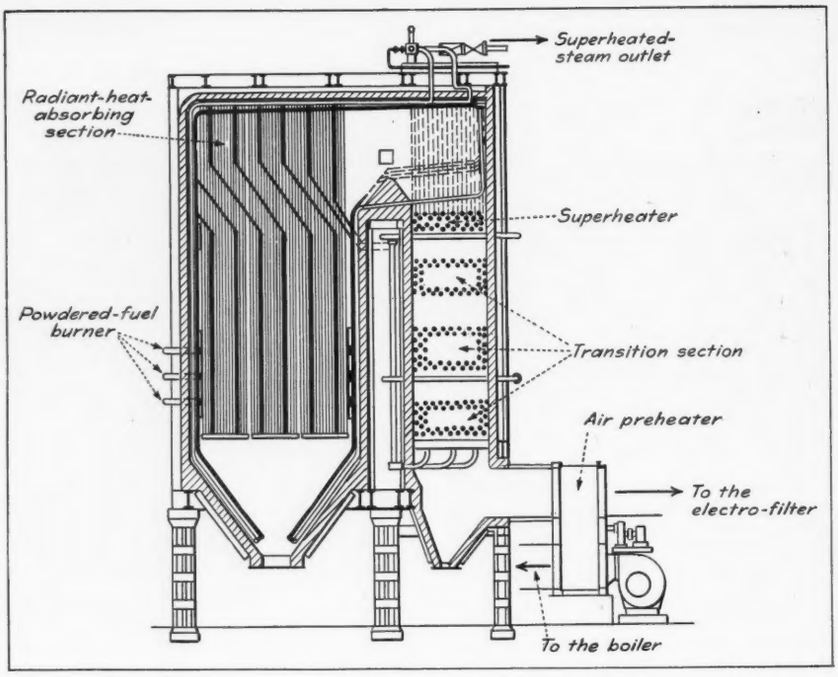

Fig. 3—Benson boiler with corner firing

About half of the Benson boilers in operation are controlled manually and half automatically. Siemens and Halske have developed a control using Wheatstone bridges in combination with grid-controlled rectifier tubes. The resistance in one leg of the bridge changes in response to the demand; that in another leg compensates by changing resistance in response to boiler operation.

Because of economic conditions in Germany, no new Benson boilers were installed between 1929 and 1933. Since then there have been many installations, so that today 82 boilers are in operation or under construction. These include 43 (average rating 176,000 lb per hr) for industrial plants with back-pressure or extraction-condensing operation; 14 (average 264,000 lb per hr) for public-utility condensing plants; 6 (average 26,000 lb per hr) for universities, test, etc; and 19 (average 73,000 lb per hr) for merchant ships. These were manufactured by the following firms under license from S S W: Rheinmetall-Borsig, Berlin-Tegel; Duerrwerke, Ratingen-Ost; Walther & Cie, Koeln-Dellbrueck; Vereinigte Kesselwerke, Duesseldorf; Krupp Germaniawerft, Kiel-Gaarden; and Werft, Blohm & Voss, Hamburg.

The following table shows how Benson boilers have shared in the total high-pressure boiler orders placed in Germany, for pressures from 1150 to 2150 lb, considering stationary units only:

	Number	*Percent of total number*	*Percent of total capacity*
Stirling	83	44.0	48.7
Benson	58	30.7	31.5
Schmidt	26	13.8	10.0
Sulzer	11	5.8	5.2
Sectional	5	2.6	2.3
Loeffler	5	2.6	1.7
La Mont	1	0.5	0.6
Total	189	100.0	100.0

The following table lists Benson boilers installed on German merchant-marine ships:

Ship	*Year installed*	*No. of boilers*	*Press., lb.*	*Temp, F*
Uckermark	1928	1	710	800
Potsdam	1935	4	1280	880
Pretoria	1936	2	1140	840
Windhuk	1936	2	1140	840

Among outstanding installations are two boilers for tubine testing (55,000 lb each max continuous rating) that have been installed in the Muelheim Works of S S W. These are combination gas-oil fired without air preheaters.

At Scholven, in the Ruhr, five 220,000-lb-per-hr boilers supply steam and power to a large chemical plant. A sixth is under construction. Steam, generated at 1780 lb and 990 F, is reduced to 185 lb in Ljungstroem tur-

75 YARWAY IMPULSE TRAPS Serve PEPPERELL at Lindale, Georgia

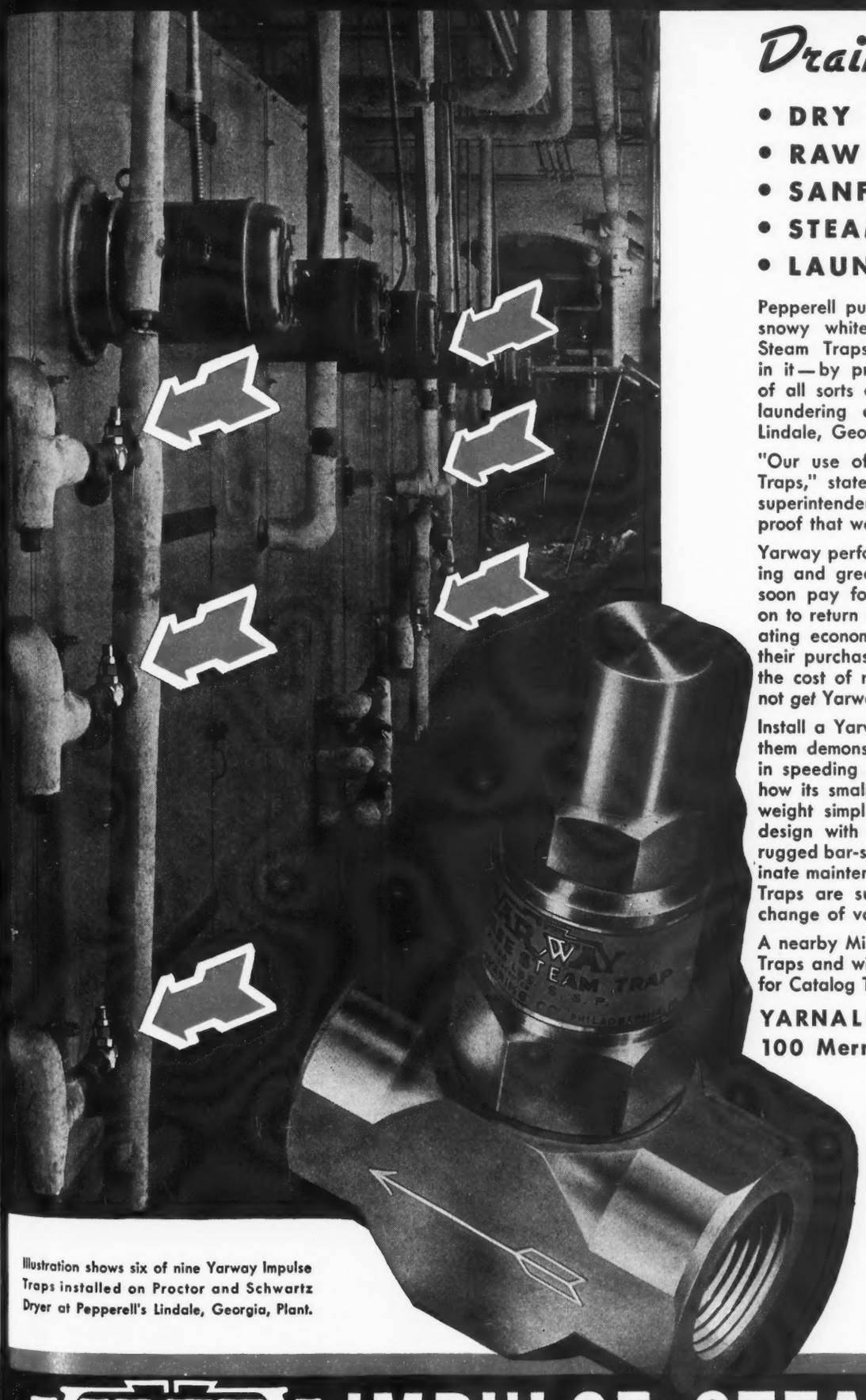

Illustration shows six of nine Yarway Impulse Traps installed on Proctor and Schwartz Dryer at Pepperell's Lindale, Georgia, Plant.

Draining

- DRY CANS
- RAW STOCK DRYERS
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Pepperell puts the nation to sleep — between snowy white sheets. And Yarway Impulse Steam Traps are proud to have a hand in it — by providing more efficient operation of all sorts of steam-heated processing and laundering equipment in Pepperell's great Lindale, Georgia, Plant.

"Our use of this large number of Yarway Traps," states Mr. Comer Turley, mechanical superintendent of this plant, "is conclusive proof that we are well satisfied with them."

Yarway performance talks. Their quicker heating and greater sustained heating efficiency soon pay for their installation and continue on to return worth-while profits in plant operating economy. And when you consider that their purchase price is usually no more than the cost of repairing an ordinary trap — why not *get* Yarway performance for *your* money?

Install a Yarway Impulse Trap or two and let them demonstrate what they can do for you in speeding production and saving fuel. See how its small size saves space. How its light weight simplifies installation. How its unique design with only one moving part, and its rugged bar-stock construction, practically eliminate maintenance expense. Then too, Yarway Traps are suitable for all pressures without change of valve or seat.

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YARWAY IMPULSE STEAM TRAP

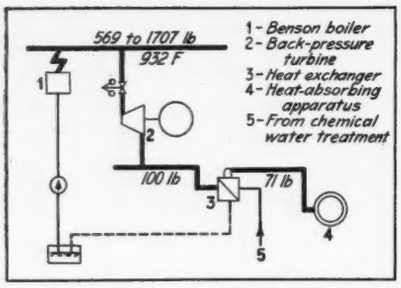


Fig. 4—Steam connections of back-pressure plant with variable-boiler-pressure operation

bines and is then reheated by boiler steam. Reheaters reduce main-steam temperature to 842 F at throttle of high-pressure turbines. Reheated 185-lb steam goes partly to condensing turbines and partly to steam transformers generating process steam.

In October, 1937, two somewhat similar boilers (but without water screens) were placed in service by Niederschlesische Bergbau A G at Waldenburg. Steam, generated at 1780 lb and 932 F, expands to 199 lb in high-pressure turbine, is then gas-reheated and expanded in a condensing turbine. Another pulverized-coal-fired boiler has been installed in the S S W cable works.

Fig. 3 shows one of six boilers with corner firing under construction by Kohlenscheidungs-Gesellschaft for a large plant. Low-grade and slime coal will be fired in pulverized form.

Cost Comparison

The cost of a Benson boiler is largely independent of the pressure. In German experience, price breaks even with drum types at 570 lb and is 20% less than drum types at 1400 lb. The drum types have greater storage capacity.

Following, in brief, is the variable-pressure system of operation: All regulating devices of turbine are completely open, so that steam flow and electrical output depend only on boiler pressure. When turbine load falls, boiler pressure also falls. Steam mass flow is reduced almost in direct proportion to pressure. Since steam specific volume is correspondingly greater at the lower pressure, the volume of steam flowing to the turbine is practically independent of load and pressure.

As a result, turbine efficiency is practically constant at all loads. Over-loads are carried by increasing the boiler pressure. When this system is used with a Benson boiler, throttle temperature can be kept constant at all loads. The lower pressure at partial load greatly reduces feed-pump power consumption.

Process Controls Load

Fig. 4 diagrams a simple back-pressure plant for variable-pressure operation. Here the generator feeds a power system which can absorb any power delivered by the turbine. Steam flow is determined solely by low-pressure steam requirements for process, etc. The turbine runs with regulating devices completely open, speed regulator operating only when normal speed is exceeded by a specific amount. Pressure changes in low-pressure system regulate boilers. If necessary, heat exchangers with considerable storage may be provided. The hookup and data on Fig. 4 apply to the installation at the S S W cable works.

Fig. 5 shows how this system is applied with complete or partial condensing operation. In such plants the condensing turbine controls the frequency, while the high-pressure turbine uses all steam supplied by the boilers. In other words, electrical load fluctuations are first taken on the condensing turbine, with the result that the intermediate pressure shows a tendency to change. This variation is used to regulate the boiler, either manually or automatically. This method is always applicable where the plant operates in parallel with others and is not required to maintain the frequency of the system.

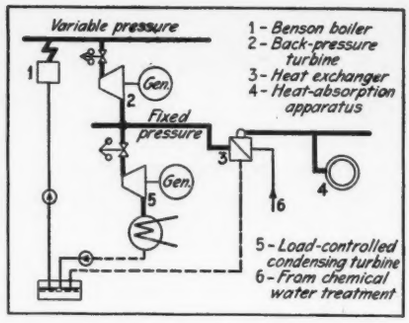


Fig. 5—Steam connections of an extraction-condensing plant with variable-pressure operation

In isolated plants, however, or in plants controlling frequency, the variable-pressure method can be used only if the intermediate-pressure system contains sufficient storage, such as is provided by heat exchangers shown in Figs. 4 and 5. In condensing plants, storage capacity can be provided by low-pressure boilers or other steam-storage devices.

In the author's personal opinion, most economical performance of a plant where turbines exhaust to a heating system is obtained with constant maximum boiler pressure if the turbine is equipped with nozzle group control. (The author makes other interesting comparisons of constant and variable pressure, but space does not permit reviewing them here—Editor).

✦ ✦ ✦

Questions for Boiler-Room Engineers

By HARRY M SPRING

Q—In thick-walled boiler drums, how are tube holes prepared so that a high unit pressure may be secured for the expanded seat without excessive power for expanding?

A—Tube holes are counterbored for part of the thickness so that expanded section of tube is less than the full thickness of the drum.

Q—Should the counterbored section be started from the internal or external surface of the drum?

A—If the tubes come out of the lower side of the drum, the counterbore is usually external to prevent internal pockets for scale or oxidation. If tubes come out of upper side of drum, the counterbore is usually internal to avoid soot pockets on the external surface which would tend to cause corrosion when the boiler is out of service and the tubes sweat.

Q—Name three major causes of leaking tube ends at the rear of the upper row in an hrt boiler, in order of frequency of occurrence.

A—Low water, internal surfaces of rear tube sheet fouled by oil or scale, front end of boiler settled.

Q—Describe water hammer in detail.

A—It is a disruptive shock and stress that may be set up in pipe lines by: a sudden restriction of flow (due to momentum); a sudden change in direction of flow (due to momentum); or a sudden increase in flow (due to reactive effect of inertia). Examples of conditions causing water hammer are: the sudden shutting down of a quick-opening blowdown valve on a boiler under pressure; a slug of water in a steam line meeting a 90 degree elbow; the sudden opening of a valve controlling fluid under high pressure.

Q—How would you tell that an hrt boiler is settled at the rear when in operation?

A—Examine clearance around blowdown pipe passing out through rear wall.

Q—When a steel boiler is left idle for several months, should it be left empty or full of water?

A—It should be left open, empty, and dry.

Photo News Valve values

THE EDWARD VALVE & MFG. CO., INC. • EAST CHICAGO, INDIANA

EVERY POWER HOOK-UP CALLS FOR EDWARD VALVES

PICTURES SHOW TYPICAL EDWARD DESIGNS FOR KEY POSITIONS IN MODERN POWER GENERATING PROJECTS, AND EQUIPMENT USED TO KEEP EDWARD QUALITY UP TO PAR

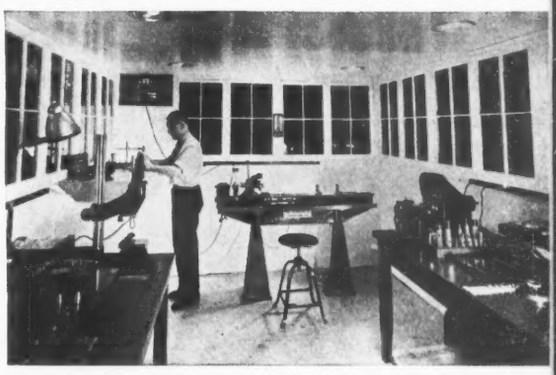
DEFINITELY UNIQUE are Edward "separated" stop-check feedline valves, for installation at the boiler drum or economizer inlet. They represent the simplest and most effective means of meeting code requirements. These two-in-one valves are built for right hand or left hand feedwater lead connection.

THIS STREAMLINE NON-RETURN valve with welding pipe ends is a good example of best current design in Edward valves. Shown is an 8″ 600 lb elbow vertical C-Mo Edward non-return valve with, of course, Edward Impactor handwheel for enhanced power in closing against test pressure and ease of operation under all circumstances. This compact model stands about four feet high and weighs close to half a ton. Seat and disk have Stellited contacts.

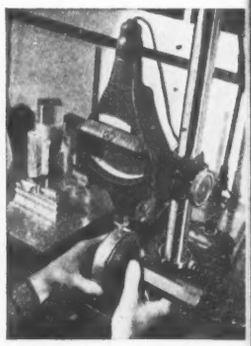
WELDING END BLOW-OFFS are part of an unmistakable trend in current hook-ups, which explains these 1500 lb primary rating forged steel Edward blow-off valves. Frequently Edward blow-off valve tandem combinations are welded together in Edward's modern welding department under strict laboratory oversight.

PRECISION!

Edward shop practice begins with precision measuring, exact to the sixth decimal point. Reliable functioning of working elements of Edward valves, interchangeability of maintenance parts, positive control of operation, long life and low cost, all are related to machine shop methods. To make sure that working gages control dimensions within prescribed limits, measuring devices of almost unbelievable accuracy are needed. Edward's measuring system is founded on standard measuring blocks of accuracy of the order of 0.000004″ and measuring equipment of the order of 0.000010″.

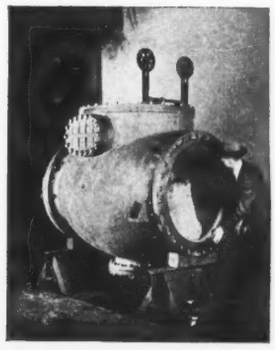


In Edward air-conditioned measuring-room (above) gages and tools are checked systematically at predetermined intervals. Master measuring machine (background), with electrically actuated pressure controlling tailstock, determines sizes up to 48″ in increments of 0.000010″. Comparator on bench at right projects greatly magnified thread contours.



Left—checking with optical flats the sphericity of relief and check valve balls by master size block and interference bands from monochromatic light source. Right—precision verification of working plug gage by use of frictionless reed-controlled light beam.

FORGED STEEL EDWARD STOP VALVES always come to mind in connection with modern power hook-ups. Edward screwed end straightway design is made up of pedigreed components, each designed and built for hard use on basis of years of field service. New lightweight malleable iron handwheel, with knobs for firm grip, facilitates operation and gives leverage for tight contact. Check valves also available.



EDWARD ATMOSPHERIC RELIEF VALVES, sizes 6″ to 48″, occupy important positions in power hook-ups the country over. Generous dimensions — center to face equal to nominal pipe size — built of laboratory tested materials — design details carefully evolved through the years — present models represent revolutionary improvement. Cut shows one of four similar condenser relief valves furnished in connection with one recent steel plant modernization program. Disk is counterbalanced by weight and cable for sensitive response to pressure change. See sheaves mounted on top valve cover. Big manhole on side is for observation.

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Stop · Check · Blow-off · Non-return · Feed Line · Relief · Bleeder Line · etc.

Stretching the Coal Dollar

Better coal at lower cost, intelligent purchasing, and efficient combustion are goals sought by engineers representing producers and consumers at meetings of Fuels Division, ASME and Coal Division, AIME

INCREASING efficiency of coal use and coal production was the common interest of engineers gathered at Chicago, Oct 13-15, for the second joint meeting of the ASME Fuels Division and the AIME Coal Division. Other sponsoring groups included Western Society of Engineers, Illinois Mining Institute, Indiana Mining Institute, and Chicago sections of the ASME and AIME.

Outstanding from the power engineer's point of view was a session devoted to use of low-grade fuels and to coal-purchasing problems. Coals with low heating values (8500—12,000 Btu), high ash and high moisture (up to about 15% each), high sulphur (up to 6%) and low ash-fusion temperature (down to 1800 F) are commonly known as low-grade fuels, said Ollison Craig, Riley Stoker Corp, in discussing "Use of Low-Grade Coals in Modern Steam-Generating Equipment." Such coals are commonly burned on chain-grate, spreader, or underfeed stokers, or in powdered form.

After discussing each stoker type briefly, Mr Craig considered pulverized-coal firing at some length, illustrating with cross sections of boilers and furnaces. Discussion brought out the importance of considering steam cost rather than efficiency in evaluating performance of equipment burning low-grade coals. Also stressed was the need for data on maintenance costs with low-grade coals, and the importance of the flyash problem.

Coal buying is the purchasing agent's toughest job, in the opinion of T W Harris Jr, of E I DuPont de Nemours & Co, who opened a panel discussion of coal purchasing in which the viewpoints of the purchasing agent, the coal salesman, the consumer and the producer were presented. Listing 19 points the purchasing agent must consider in buying coal, Mr. Harris told of work undertaken by the National Assn of Purchasing Agents to clarify some of these factors and stressed the need for standardized indices for size, caking qualities, grindability, and storage properties.

Tom Marsh of Iron Fireman (left) and Charles N Lammers, Fuel Service Engineer, Chicago and Eastern Illinois Railway Co, compare notes

Purchasing for a municipality, according to T Jeffords, City of Detroit, is usually on specification and depends on knowing kind of coal wanted, on a desire to get it at the lowest price per heat unit, and on a willingness to buy from any dependable bidder. Specifications should be flexible, giving maximum choice. In operating on the specification system of coal buying, reliable testing is vital; sampling is the biggest problem involved.

After describing various coal qualities important to the consumer, A W Thorson, Detroit Edison Co, outlined the procedure followed by that company. A continuous search is made of sources of supply; small shipments of apparently suitable coals are evaluated on a heat conversion basis and checked for burning and storing qualities. Coals meeting these requirements are put on the approved list and maintenance costs are watched for a year or two before final approval.

Uniformity and reliability of supply are the most important considerations in the average plant's coal buying, according to B Gebhardt, Chicago, Wilmington and Franklin Coal Co, who represented the point of view of coal sales. The cost of administering a system of buying on a specification basis outweighs the savings possible for most small plants. Size and moisture content may be most important consideration in these cases, and special preparation may be the answer to segregation problems. Mr Gebhardt also pointed out a probable effect of the trend to mechanical firing in small plants; increased demand for small sizes is likely to force up price of steam coal.

Coal Preparation

Speaking from the viewpoint of coal preparation, J B Morrow, Pittsburgh Coal Co, said the effect of mechanical mining and preparation is to produce, at low cost, coal that will make for low plant costs. He stressed the importance of sampling and indicated that as yet, too little was known to permit writing airtight specifications for coal.

If the number of hydrogen atoms in coal is approximately doubled, a material similar to petroleum should be obtained, said Dr H H Storch, Bureau of Mines, in describing the Bureau's experimental coal-hydrogenation plant. The paper, prepared jointly by Dr Storch and A C Fieldner, also of Bureau of Mines, outlined the history of methods of producing petroleum

M D Engle, Edison Electric Illuminating Co, Boston, extends the welcome of the ASME Fuels Div, of which he is chairman

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How should an engineer go about making a rapid check test of hardness in boiler feedwater?

(See Bulletin 6A)

THE NALCO QUESTION BOX

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(See Bulletin 28B)

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PARTIAL LIST OF BULLETINS

No. 6-A: "Standard Methods of Water Analysis and Interpretation of Results." "Nalco AB System." "Nalco System for Softening Plants." No. 21-B: "Control of Boiler Blowdown." No. 28-B: "Anti-incrustants for Use in Feed Lines, etc." No. 29: "Clarification of Water." "Nalco Water Testing Equipment Catalog."

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Inquiries other than domestic *except those from U. S. Possessions, Canada and Mexico,* should be addressed to ALFLOC LTD., Bush House, Aldwych, London, W. C. 2, Eng. Canadian inquiries should be sent to ALUMINATE CHEMICALS LTD., 372 Bay St., Toronto, Ont.

from coal by hydrogenation, with particular emphasis on the development of catalysts to speed the reactions. The Bureau of Mines plant was built to assay the adaptability of American coals to hydrogenation, and consists essentially of a hydrogen-production plant and a coal-liquefaction plant. Data from an assay made on Bruceton coal from the Pittsburgh seam was included in the paper.

Ash Fusibility

An investigation of the effect of coal preparation on ash fusibility was reported by L C McCabe and O W Rees of the Illinois State Geological Survey. Samples from ten mines, representing all important beds and producing districts of Illinois, were float-and-sink tested and samples from the float-and-sink fractions were studied for ash-fusion properties. According to Mr McCabe, the greatest difference in ash-softening temperature was obtained in sized coals of narrow specific gravity range, and the effect, in general, of combining portions of narrow specific gravity range is to lower high softening temperature values and to raise low softening temperature values of these individual portions.

Getting away from full concentration on coal and combustion, attention was given to another boiler-room problem—feedwater. "Conquering Nightmares of Water Conditioning" was presented by R E Hall and E P Partridge of Hall Laboratories, Inc, who

L A Shipman, Southern Coal & Coke Co, (right) makes a point to E R Kaiser, Battelle Memorial Institute

in a series of case studies, covered various phases of the feedwater problem such as cracking tube ends, steam line and turbine deposits, and desuperheating. Consideration was also given to cleaning new boilers, and to scale in condenser tubes.

Delivery of coal to buildings in Chicago's Loop district, and ash and rubbish disposal, are simplified by the 60 miles of tunnel operated by the Chicago Tunnel Co. These facilities, which relieve the streets of approximately 5000 truck movements per day, were described by J F Peterson, of the Tunnel Co. After his talk, the engineers present made an informal inspection of the system.

Other inspection trips included a visit to a large strip coal mine of the Northern Illinois Coal Co, at Wilmington, Illinois; to the Inland Steel Company's plant at Indiana Harbor, Ind.; Goodman Mfg Co; and Fisk Station.

Other Papers

Additional papers presented included: "Influence of Mechanization on Location of Coal Production in Illinois" by Paul Weir, Consulting Engineer, Chicago; "Fundamentals of Combustion in Small Underfeed Stokers" by C A Barnes, Battelle Memorial Institute; "Iowa Coal as a Domestic Stoker Fuel" by M P Cleghorn, Iowa State College; "Factory Testing of Propeller Mine Fans" by Raymond Mancha, Jeffrey Mfg Co; "Mechanical Mining at Consolidated Coal Co" by G S Jenkins.

"Materials Handling in Coal Preparation Plants" by N L Davis, Link Belt Co; "Haulage in Strip Coal Pits" by A L Toenges, Bureau of Mines; "Safety Practices of the Koppers Coal Co" by L C Campbell; "Recent Trends in Rock Dusting to Prevent Dust Explosions in Coal Mines" by H P Greenwald, Bureau of Mines; "Organized Safety in the Anthracite Mines of the Susquehanna Collieries Co" by Clyde G Brehm; "Coal for Metallurgical Furnace Firing" by W R Bean, Whiting Corp.

Engineers' Bookshelf

Hydraulics

APPLIED HYDRAULICS (2nd Edition—1938). *By Herbert Addison, Professor of Hydraulics at the Egyptian University, Giza, Egypt. Published by John Wiley & Sons, Inc, 44 4th Ave, New York, N. Y. 435 pages, 5½x8½ in., 337 illustrations, cloth binding. Price $5.50.*

Although written as a college text, the author has kept the practicing engineer in mind and has tried to make this book meet his needs. To this end, the work has been divided into three parts. In the first part the more fundamental subjects are covered, such as liquids and their properties, static pressure in liquids, flow of liquids through orifices and over weirs, flow of liquid in pipes and channels, dynamic pressure of liquids and rotary motion of liquids.

The second part of the book is written for the practicing engineer, particularly those engineers who need to be familiar with performance rather than with mechanical details of pumps and turbines. Here are considered pipeline systems, automatic control, hydraulic turbines, pumps, hydraulic transmission and storage of energy and hydraulic measurements. The third section of the book comprises solutions of 120 practical hydraulic-engineering problems. Engineers who only occasionally have to deal with such problems will find these an invaluable reference and guide.

In the new edition the chief changes comprise expansion of certain sections that were unduly compressed in the earlier edition, and the addition of a chapter on screw and propeller pumps.

Metallurgy

METALLURGY (1938). *By Johnson, Dean and Gregg. Published by American Technical Society, Drexel Ave at 58th St, Chicago, Ill. 149 pages, 5½x8¼ in., 82 illustrations. Price $1.50.*

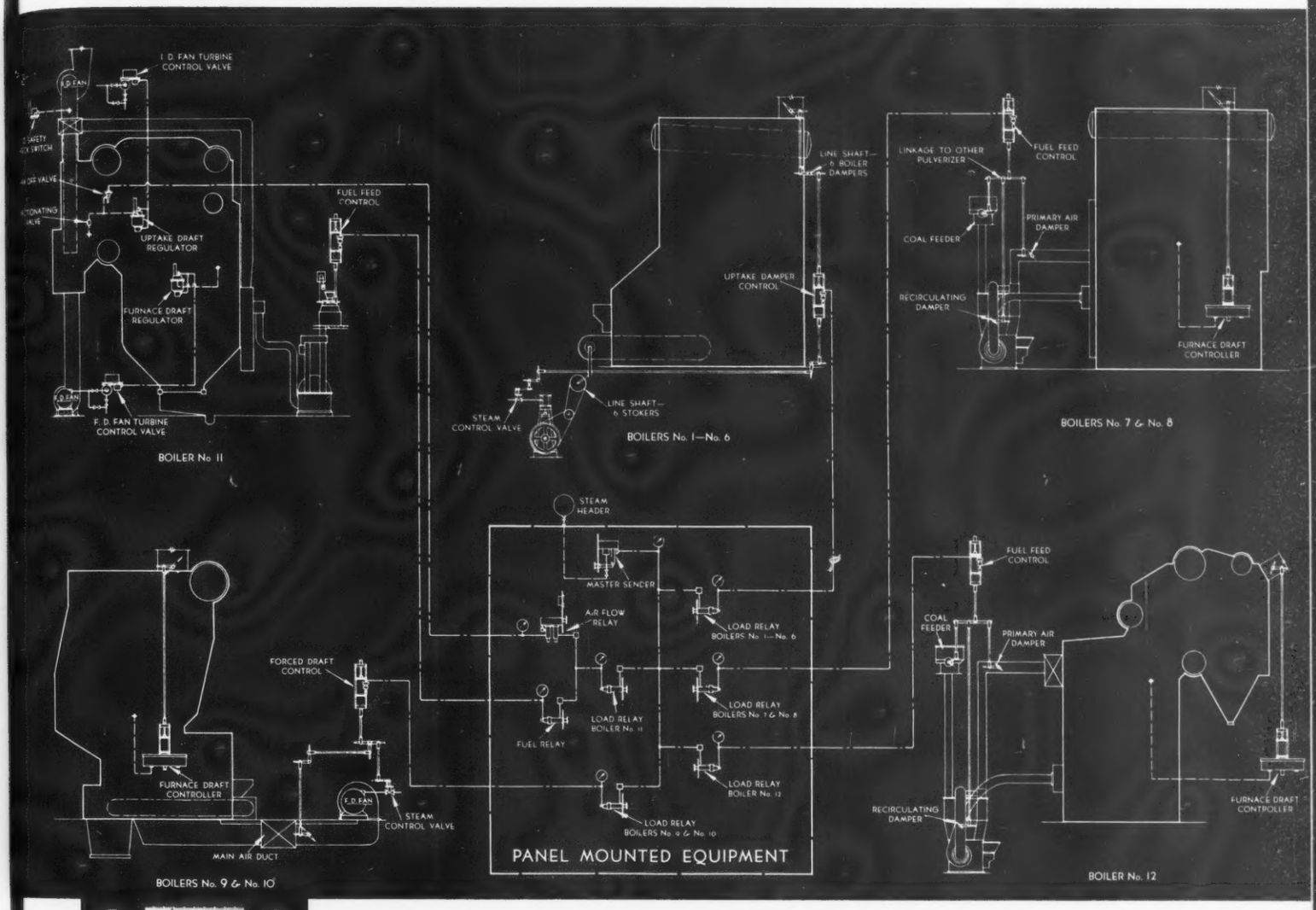
This book on metals and alloys explains how they are composed, cast, worked and fabricated, and gives their important properties in simple language that can be understood without resort to elaborate technical terms. Recommended for operators who want a digest of up-to-date information but have little previous knowledge of the technical phases of the subject.

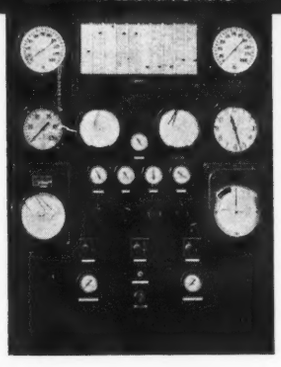
Welding

OXYACETYLENE WELDING (1939). *By Robert J Kehl. Revised by Morgan H Potter, Welding Instructor, William Hood Dunwoody Industrial Institute. Published by American Technical Society, Drexel Ave at 58th St, Chicago, Ill. 130 pages, 5½x8 in., 116 illustrations, 5 tables. Price $1.25.*

Written in a how-to-do-it style, this book deals with the oxyacetylene process, technique of oxyacetylene welding, welding for different metals, steel and cast-iron welding, welding on vertical and overhead positions, pipe and bronze welding. Also hand surfacing, silver

Here's *Flexible* Combustion Control!





Hagan Centralized Control Panel at a prominent midwestern university automatically controls the combustion of 12 boilers in four groups. The diagram shows the method of hook-up. Manual operation of this plant without centralized control would be a formidable job.

This Hagan unit controls 12 boilers having different operating characteristics and fired by four different fuel-burning systems.

THE Hagan Unit System of Automatic Combustion Control at a large midwestern university is of special interest because of the widely differing types of boiler units and combustion apparatus it successfully controls from one central point. The fuel-burning equipment consists of natural-draft chain-grate stokers, forced draft-chain-grate stokers and two types of powdered fuel apparatus.

This boiler-room equipment, installed during the past 15 years, includes Hagan Control Apparatus from its most rudimentary but dependable form up to the extremely flexible control available today. Hagan control has always been sufficiently flexible to meet varying requirements. As each new unit was added, the combustion control was extended, utilizing latest developments to provide a system that functions as a unit to control all boilers. The final control system increased boiler-room efficiency approximately 10 per cent.

Practically no maintenance has been required. Original apparatus continues to function satisfactorily with few adjustments. This operating record is the best proof of the durability and reliability of Hagan apparatus.

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soldering, malleable iron, white metal or die castings, aluminum, copper, brass and bronze welding, cutting and lead burning, design of jigs for oxyacetylene welding and the cost of welding. The material is presented from the welding-operator's point of view with many practical illustrations of how to do various kinds of welding jobs.

Electricity

ELECTRICAL MACHINERY (Second Edition —1938). *By F A Annett, Associate Editor,* POWER. *Published by McGraw-Hill Book Co, 330 W 42nd St, New York, N. Y. 521 pages, 6x9 in., 494 illustrations. Cloth binding. Price $3.00.*

Written as a study course in magnetism and electricity for electricians, mechanics and power-plant operators, this book considers magnetism, electricity, dc and ac circuits and machinery. The first part is devoted to a study of magnetism, properties of permanent and electromagnets and electric circuits. The author's experience in teaching industrial electricity to practical men and in directing men on the job has shown that engineers can get wrong conceptions of theory or find it difficult to get clear ideas of certain elementary laws. In the preparation of this book, particular effort has been made to guide students around these pitfalls, and to have all electrical problems deal with things that the practical man comes in contact with in his daily work.

In the revision, about 100 pages have been omitted from the first edition and new material substituted. This includes a chapter on locating position of brushes on a commutator; new and enlarged chapters on transformers, alternating-current motors, and starting alternating-current motors; and a new chapter on electron tubes. The latter covers the various types of electron tubes used for metering, control, and power-rectification purposes.

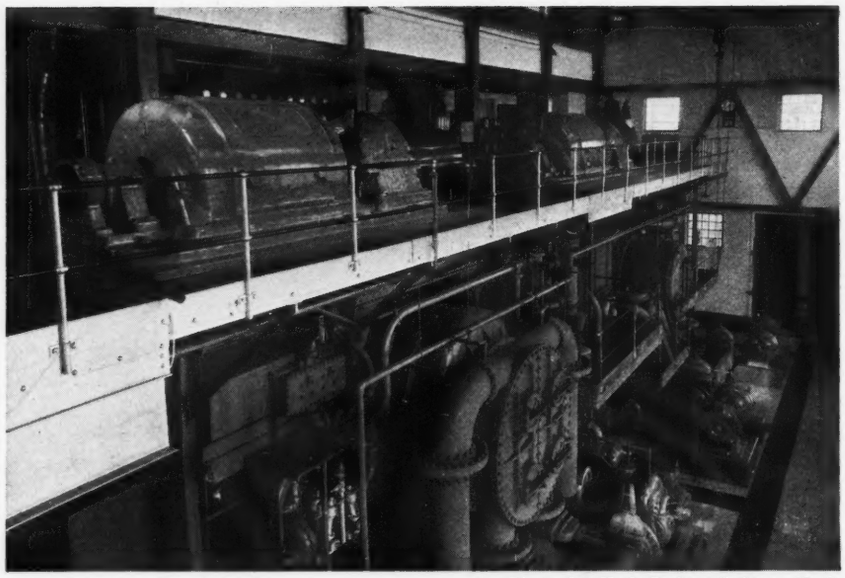
A C Motors

WINDING ALTERNATING-CURRENT MOTOR COILS (1938). *By G A Van Brunt, Associate Editor,* FACTORY MANAGEMENT AND MAINTENANCE, *and A C Roe, Transportation Engrg Dept, Westinghouse Electric & Mfg Co. Published by McGraw-Hill Book Co, 330 W 42nd St, New York, N. Y. 281 pages, 6x9 in., 270 illustrations, 30 tables, cloth binding. Price $3.00.*

Electrical machinery is no better than the insulation on its windings. If this is defective, the machine soon fails and becomes inoperative. Therefore, in winding or rebuilding old machines, careful attention must be given to insulation. Many older machines have coils that are both difficult to make and to insulate.

It is to the problems of reliable insulation and modernizing old types of ac motors and generators that this book is devoted, also design, construction and insulation of modern types of coils for both low- and high-voltage machines. Suggestions and examples of best procedure in replacing old windings by modern designs are given. The last chapter gives information on properties and applications of glass-fabric insulating materials that have been developed recently.

The treatment is practical and gives a wealth of useful information for those interested in electrical-machinery winding problems.



—Photo by H O Dodge, Sydney, N. S.

KVA'S FOR NOVA SCOTIA

Brown-Boveri, 7500-kva, 3600-rpm turbine-generator was recently installed by Swiss Electric Co of Canada at Dominion Steel & Coal Corp's Seaboard Station, near Glace Bay, Nova Scotia. First operation of this plant was in May 1930, with two 9219 sq ft Stirling pulverized-coal-fired boilers generating steam at 450 lb and 650 F, and one 7500-kva, 3600-rpm turbine-generator. The new unit brings plant capacity to 15,000-kva, for which present boilers are adequate

Definitions

ENGINEERING TERMINOLOGY (1938). *By Victor J Brown and Delmar G Runner. Published by Gillette Publishing Co, 330 S Wells St, Chicago, Ill. 310 pages, 6x9 in. Price $3.50.*

Concise definitions in dictionary form of terms that appear in specifications and contracts. This book puts the language of the engineer on paper and defines geological, architectural and other engineering terms in their technical sense, which often is quite different from the usual dictionary meaning. English-Spanish highway nomenclature is given in an appendix as are several other special groups of definitions and symbols.

Thermodynamics

ELEMENTARY THERMODYNAMICS (1938). *By V M Faires. Published by The MacMillan Co, 60 Fifth Ave, New York, N. Y. 225 pages, 6x9 in., 102 illustrations, 338 problems. Price $2.60.* APPLIED THERMODYNAMICS (1938). *By V M Faires. Published by The MacMillan Co. 374 pages, 6x9 in., 200 illustrations. Price $3.90.* PROBLEMS ON APPLIED THERMODYNAMICS (1938). *By V M Faires and A V Brewer. Published by The Macmillan Co. 137 pages, 6x9 in. (paper cover) 1403 problems. Price $1.40.*

While these books are closely associated with each other, they do not form a series. *Elementary Thermodynamics* is a college text for a short course in the subject. *Applied Thermodynamics* contains the same material with such added chapters as engines, power plants and the transfer of heat. Both volumes and the book of problems are intended as college texts and presuppose knowledge of physics, mechanics and calculus.

THERMODYNAMICS, FLUID FLOW AND HEAT TRANSMISSION (1938). *By Huber O Croft. Published by McGraw-Hill Book Co, 330 West 42nd St, New York, N. Y. 312 pages, 6x9 in., illustrated. Price $3.50.*

A concise review of thermodynamics, an introduction to dimensional analysis and succeeding chapters on fluid-flow and heat-transmission problems are combined into a continuing text. Examples and problems are practical and illustrative of this complex subject.

BRIEF REVIEWS

THE ELECTRIC LIGHT & POWER INDUSTRY IN THE U. S. (1938). *Published by Edison Electrical Institute, 420 Lexington Ave, New York, N. Y. Price 30 cents to members and their employees, 75 cents to non-members in U. S. A.*—Sum-

(*Continued on page* 132)

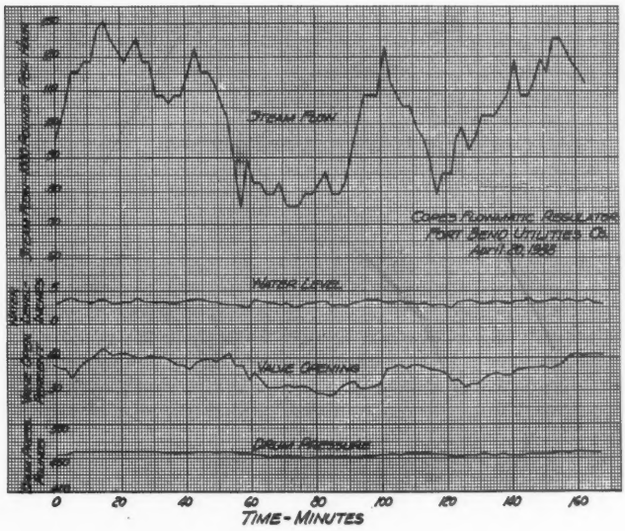
LOAD LEVEL

Fluctuating—within limits of 75,000—150,000 pounds per hour

Practically constant—extreme range of plus or minus one inch

At Fort Bend Utilities Company

The all-outdoor Riley Steam Generator carries a combined utility and sugar plant load. The steam demand fluctuates rapidly and over a wide range. The COPES Flowmatic Regulator was installed and adjusted without need of factory service. There is an extreme water level variation of plus or minus one inch.



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We have just published an 8 page paper about the Fort Bend plant. It describes the major equipment, analyzes the steam demands and discusses results obtained with the new COPES Flowmatic Regulator. It is illustrated with photographs, charts and diagrams. Write today for a copy of this interesting paper.

Fort Bend proves the value of the Flowmatic

Easy installation, simple adjustment, trouble-free operation with only routine attention, close boiler water level control on the most rapidly swinging loads. These are the reasons why the new Flowmatic made good at Fort Bend—why it will make good on your fast-steaming generators.

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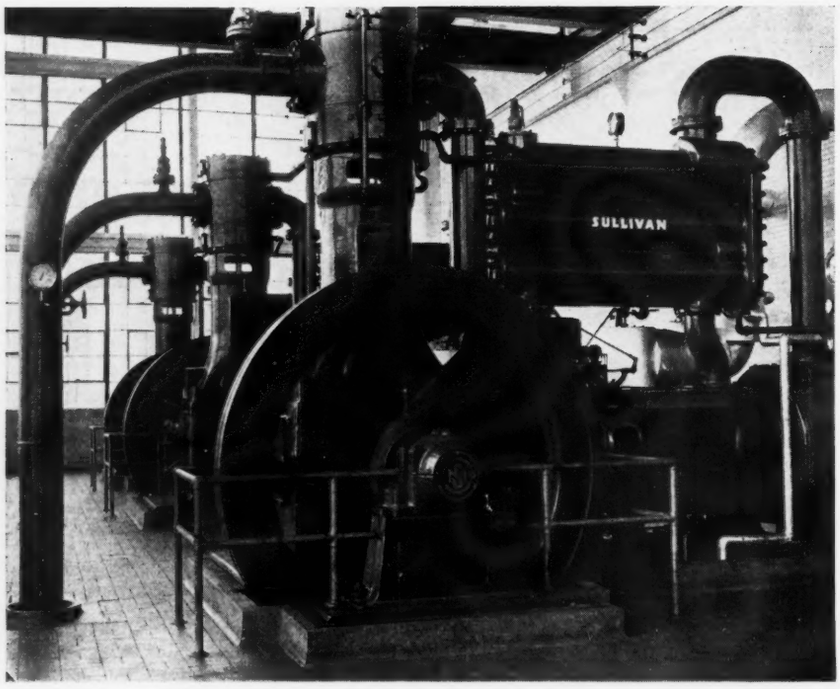

GENERAL MOTORS ON AIR

Compressor room in the new power house of the Ternstedt-Trenton Div of General Motors, Trenton, N. J. There are three steam-driven air compressors, each with a capacity of 2200 cfm at 125 lb pressure. In the boiler room, three 6000-sq ft water-tube units generate steam at 200 lb. Boilers are fed by multiple underfeed stokers with automatic combustion control

Power Lines

ASME Annual Meeting in New York, Dec 5-9

Preliminary plans for the 59th Annual Meeting of the American Society of Mechanical Engineers, to be held in New York, N. Y., Dec 5-9, indicate a program of widespread interest to power engineers.

It has been relatively a few years ago that the first high-pressure, high-temperature steam boiler and turbine were installed. Since then, though many plants have been so equipped, engineers are still encountering many problems in operating these new units, according to papers to be presented about the installations at Detroit. Operation of the furnaces to be used with the new boilers will be discussed by E G Bailey, Babacock & Wilcox Co.

Effect of high-pressure, high-temperature steam on flow measurement will be covered by two papers. A committee will report on the effect of high-temperature steam on alloys. Joseph H. Keenan, who compiled the well-known "Steam Tables and Mollier Diagram", will present a paper on "Friction Coefficients for the Compressible Flow of Steam". At the same session, reheat factors for superheated- and wet-steam expansion will be discussed by C G Thatcher, and the calculation of reheat factors for steam turbines by Ronald B Smith.

Many power and industrial plants are faced with the problem of controlling explosions caused by coal and other dust. A method of control, developed by the U. S. Dept of Agriculture, will be described by one of its engineers.

Utilities and Government to Cooperate in Expansion

Expansion of utility capacity in major industrial centers to the extent of 1,000,000 kw is assured as the result of a meeting October 28 between high officials of 14 utility companies and the National Defense Power Committee. The program is the first step in bringing generating equipment in industrial areas up to wartime requirements. The rapidity of this expansion, it is hoped, will be limited only by the ability of equipment manufacturers to make the necessary machinery.

Present at the Washington meeting were Floyd L Carlisle, Consolidated Edison Co of New York; R E Dillon, Boston Edison Co; James F Fogarty, North American Co; Charles Y Freeman, Commonwealth Edison Co; P H Gossler, Columbia Gas & Electric Co; C E Groesbeck, Electric Bond and Share Co; C W Kellogg, Engineers Public Service Co; Thomas W McCarter, Public Service Electric & Gas Co; F R Phillips, Duquesne Light Co; H Hobart Porter, American Water Works & Electric Co; Edward Reynolds, Columbia Gas & Electric Co; F E Ricketts, Consolidated Gas & Electric Co of Baltimore; A H Schoelkopf, Niagara-Hudson Power Corp; E S Thompson, American Water Works & Electric Co; Herbert Wagner, Consolidated Gas & Electric Co; Wendell L Willkie, Commonwealth and Southern Corp; John E. Zimmerman, United Gas Improvement Co.

Representing the government were Louis Johnson, Assistant Secretary of War; Charles Edison, Assistant Secretary of the Navy; Basil Manly, vice-chairman of the Federal Power Commission; Frederic A Delano, vice chairman of the National Resources Committee, and E K Berlew, Assistant Secretary of the Interior (representing Secretary Ickes). In addition there were Major Thomas X R Tate and Capt W R Winslow of the Army and Commander K B Bragg of the Navy, as well as Benjamin V Cohen and Thomas G Corcoran.

The immediate effect of the program, according to Mr Carlisle, will be the placing of orders for some $350,000,000 in equipment, and the total amount of the companies' outlay will approach $2,000,000,000 within the next two years.

No outright grants by the federal government are involved. The utilities will endeavor to finance as much as possible of the outlay through stock issues, although it is probable that part of the funds will be raised through bond issues.

These 14 companies serve industrial areas that would be called upon, in case of war, to furnish munitions, including Baltimore (and Washington) Birmingham, Boston, Bridgeport, Buffalo (and Niagara Falls), Chicago, Cincinnati, Cleveland, Detroit, New York, Philadelphia, Pittsburgh, Rochester, St. Louis and Schenectady.

Council of Engineers

The Universal Craftsmen Council of Engineers is putting into effect a new educational program for its members, and is interested in obtaining educational movies, lectures, etc, put out by various manufacturers of equipment.

F L Wadsworth, 821 Thurston Rd, Rochester, N. Y., chairman of the educational committee, is organizing district committeemen so that when features become available, they can be routed to councils throughout the U. S. Manufacturers wishing to show films, slides, etc, should write Mr Wadsworth.

ASHVE Will Meet Jan 23-26 in Pittsburgh

The 45th Annual Meeting of the American Society of Heating and Ventilating Engineers, to be held at Pittsburgh, Pa., Jan 23-26, 1939, will observe the 20th anniversary of the establishment of the ASHVE Research Laboratory.

Special emphasis at the technical sessions will be laid on research problems.

STOPS VALVE STICKING
ON COMPRESSOR
• VALVE CLEANING was a weekly job on the compressor in a central state foundry. The plant engineer had experimented with various oils but none relieved the trouble. When the Standard lubricating salesman offered the services of a Lubrication Engineer, the plant engineer accepted, but he was practically convinced that nothing could be done.
The Standard Lubrication Engineer first analyzed a sample of the deposit on the valves. It proved to be a mixture of core sand, oil and asphalt. The compressor was flushed with a soap solution and the intercooler blown down. With the system thoroughly cleaned, Stanoil No. 25 was put into the lubricator. Much to the plant engineer's surprise, he has not had a sticking valve since then. The elimination of his former weekly valve repair bill more than pays the difference in cost of Stanoil.
It's almost certain that somewhere in your plant the higher quality of Stanoil will pay its way in reduced maintenance and lower ultimate lubricating costs. Let a Standard Lubrication Engineer point out some of these places. He'll make this analysis at no cost to you. Call him at the nearest Standard Oil (Ind.) office, or write 910 S. Michigan Avenue, Chicago, Illinois.
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STANOIL
STANDARD OIL COMPANY (INDIANA)
LUBRICATION ENGINEERING
THE RIGHT LUBRICANT • PROPERLY APPLIED TO REDUCE COSTS

These will include air conditioning in industry as related to health of workers, physiological sensations of comfort, hospital air conditioning, characteristics of reflective insulation materials and the heat requirements of single- and double-glazed houses.

Also, condensation of moisture within walls of buildings, heat transfer in storage water heaters, recent advances in physiological knowledge in relation to ventilation practice, problems of air flow in ducts and weather design factors which influence air-conditioning applications. There will be a special symposium devoted to the application of solid fuels in heating and air conditioning.

More than 20 papers in which some 35 engineers, medical scientists and public health authorities will participate, have been scheduled for presentation at this meeting.

PERSONALS

HARRY W SMITH, JR has been appointed director of industrial gas publicity, American Gas Assn. Mr Smith was graduated from Case School of Applied Science in 1930, and has served the American Gas Assn at both its Cleveland and Los Angeles testing laboratories.

EDWIN R RATH, for the past four years head of the Industrial Research Dept of the University of New Hampshire, has been appointed senior engineer of the Power Transmission Council. Since graduating from the University of Pittsburgh, Mr Rath has taught

electrical engineering in that institution, done consulting work for the Duquesne Light Co and West Penn Power Co, had charge of promotion and sale of new products for Philip Carey Co, and worked on electric-furnace development for Pittsburgh Metallurgical Co.

WALLACE K BROWN was appointed vice-president and general sales manager of Crocker-Wheeler Electric Mfg Co, Ampere, N. J., effective Oct 1. Mr. Brown was educated at Clarkson Tech and the University of Illinois, starting with Crocker-Wheeler as an engineering apprentice. He was later in the Chicago, San Francisco and New York sales offices.

S A HADLEY, 416 Dwight Bldg, Kansas City, Mo., will represent The Hil-

(*Continued on page* 136)

NEW PLANT CONSTRUCTION

McGraw-Hill Business News Department Is Prepared to Furnish a More Complete Daily Service

Conn., Southbury—State, R. A. Hurley, comr. P. Wks., plans by F. J. Dixon, State Office Bldg., Hartford, and takes bids in January, constructing brick, steel, concrete institution power plant and steam and electric service lines. $610,000. P.W.A. project.

Ind., Jasper—Bd. P. Wks., J. Giesler, clk., making plans constructing addition and improvements to municipal power plant, incl. water tube boiler, piping and appurtenances. $71,400. P.W.A. project. J. M. Rotz Eng. Co., 817 Merchants Bank Bldg., Indianapolis, consult. engrs.

Ia., Dayton—Bids Dec. 5, by City, constructing power plant and distribution system. $56,000. P.W.A. project. R. W. Gearhart, 349 21st St., Cedar Rapids, engr.

Ia., Milford—Bids Nov. 28, by Town, improving municipal light and power plant, consisting 1 diesel engine generating unit of not less than 350 hp. and auxiliary equipment. $35,000. R. W. Gearhart, 349 21st St., Cedar Rapids, engr.

Ia., Mt. Pleasant—Bids Nov. 30, by City, constructing steam power plant extension, incl. 1,000 kw. turbo-generator, duct work, condenser, circulating pumps, air ejectors, condensate pump, etc. $80,000. Young & Stanley, Muscatine, engrs.

Ia., Webster City—City, A. L. Frank, mayor, plans improving municipal light and power plant and distribution system. Est. about $166,500. Buell & Winter, Insurance Exch. Bldg., Sioux City, engrs.

Kan., Coffeyville—City, c/o City Clerk, receives bids sometime before Nov. 25, chimney repairs and new crane for municipal light and power plant, incl. steam piping equipment, etc. $53,960. P.W.A. grant $24,282 approved. Black & Veatch, 4706 Bway., Kansas City, Mo., engrs.

Kan., Paola—City plans constructing light plant. $240,000. P.W.A. grant $113,312 approved. W. B. Rollins & Co., Railway Exch., Kansas City, Mo., engrs.

Miss., Canton—Bids Nov. 28, by City, at office W. F. Prosser, clk., furnishing, constructing boiler, turbine and generator for power plant. $47,800 available. J. B. Williams, Yazoo City, consult. engr.

Mo., Fulton—City, c/o City Clerk, plans constructing municipal light and power plant and distribution system improvements. $135,000. P.W.A. allotted $60,750 grant.

Mo., Kirkwood — City voted $68,000 bonds constructing municipal light and power plant improvements, incl. substation, new switchboard, regulators, cable, etc. $124,000. Application pending for $55,000 grant.

Mo., Lathrop—City final plans in progress and soon takes bids constructing rein.-con., brick municipal light and power plant building, equipment and appurtenances and distribution system. $75,000. P.W.A. allotted $33,750 grant. $41,250 bond issue available. E. T. Archer & Co., 609 New England Bldg., Kansas City, Mo., engrs.

Mo., Lees Summit—City plans constructing new power plant. $150,000. E. T. Archer & Co., New England Bldg., Kansas City, Mo., engrs.

Mo., Liberty—City defeated bonds for constructing new power plant and distribution system. $300,000. P.W.A. project. W. B. Rollins & Co., Railway Exch. Bldg., Kansas City, Mo., engrs.

Mo., Owensville—City, c/o City Clerk, plans constructing municipal light and power plant, equipment and distribution system. $106,500. P.W.A. allotted $47,925 grant. Russell & Axon, 4903 Delmar Blvd., St. Louis, engrs.

Mo., Springfield—Springfield City Water Co., J. Everett, genl. mgr., constructing 3 story, basement, 44x52 ft., brick, concrete power plant, with chemical equipment on 3rd floor to be erected northwest of here, day labor. Est. $50,000. Burgess & Niple, 568 East Broad St., Columbus, O., engrs.

Mo., Sullivan—City, c/o City Clerk, plans constructing municipal light and power plant and distribution system improvements, etc. $125,000. P.W.A. allotted $56,250 grant. W. A. Fuller Co., 2916 Shenandoah Ave., St. Louis, engrs.

Neb., York—Bids Dec. 9, by City, constructing municipal light system, incl. power house and distribution. $425,000. R. Fulton, 2327 South 19th St., Lincoln, engr.

N. J., Lakeland—Bd. Freeholders Camden Co., Courthouse Annex, Camden, rejected bids Oct. 14, constructing electric plant at Mental Hospital. $390,909. Will readvertise. Perring & Remington Co., 509 Cooper St., Camden, engrs.

O., Amherst—Bd. P. Affairs, G. C. Kaser, clk., plans constructing 1 story diesel engine powered generating plant and distribution system. $145,000. F. G. Brown & Associates, Marion, engrs.

O., Middletown—City held election Nov. 8, to vote $1,400,000 bonds, constructing light and power plant. $2,545,454. P.W.A. grant $1,145,454 approved. Froehlich & Emery, 2nd Natl. Bank Bldg., Toledo, engrs.

O., North Baltimore—City plans constructing electric plant. $194,671. P.W.A. grant $87,602 approved. C. J. Simon & Assoc., Van Wert, engrs.

Okla., Carnegie—City defeated bonds constructing municipal light plant. $63,000. V. V. Long & Co., Colcord Bldg., Oklahoma City, engrs.

Okla., Chelsea—Bids Nov. 18, by City Clerk, constructing power plant extensions, incl. new 250 hp. Diesel engine generator unit and new switchboard. $25,000. V. V. Long & Co., Colcord Bldg., Oklahoma City, engrs.

Okla., Cushing—City voted bonds for new engine and generator for power plant. $38,500. N. Barde, Cushing, engr.

Okla., Duncan — City defeated bonds, extending municipal light plant. $60,000. V. V. Long & Co., Colcord Bldg., Oklahoma City, engrs.

Okla., Drumright—City, c/o S. Whillock, soon takes bids constructing complete new electric power plant and distributing system. $280,000. W. L. Austin, Drumright, engr.

Okla., Erick—City voted bonds constructing new municipal light and power plant and electric distribution system. $60,000. V. V. Long & Co., Colcord Bldg., Oklahoma City, engrs.

Okla., Fairfax—Kaw River Hydro Authority, Fairfax, made preliminary plans constructing hydro electric plant on Arkansas River between here and Kaw City. $100,000. Applied to P.W.A. for loan and grant. T. C. Hughes, Tulsa, engr.

Okla., Perry—City voted bonds constructing municipal light plant. $45,000. V. V. Long & Co., Colcord Bldg., Oklahoma City, engrs.

Okla., Purcell—Bids Nov. 18, by City, constructing new municipal power plant and waterworks. $150,000. P.W.A. project. E. T. Archer, New England Bldg., Kansas City, Mo., engrs.

Okla., Stillwater—Oklahoma A. & M. College made sketches constructing new Diesel power plant. $675,000. P. Wilbur, Stillwater, engr.

Ore., Eugene — City, preliminary plans constructing power plant addition, incl. installation of steam turbine, generators and auxiliary equipment. $610,160. P.W.A. allotted $274,833 grant. H. P. Curin, Eugene, engr.

Tex., Eastland—M. H. Kelley, mgr., plans constructing electric light and power plant. $304,600. J. E. Ward, Harvey-Snider Bldg., Wichita Falls, engr.

Tex., Edna — City voted bonds erecting municipal electric light and power plant. $100,000.

Tex., El Campo—City, J. S. Carroll, mayor, voted bonds, constructing municipal electric light and power plant. $145,000. Freese & Nichols, Capps Bldg., Ft. Worth, engrs.

Tex., Elgin—City voted bonds constructing municipal electric power plant and system. $130,000.

Tex., Jasper—City, M. P. Hancock, mayor, voted bonds constructing municipal electric light and power plant. $175,000. P.W.A. project. Garrett Eng. Co., 308 Hughes St., Houston, engrs.

Tex., Robstown—Bids Nov. 25, by City, constructing municipal electric light and power system, electric generating unit, powerhouse, plant, underground and overhead distributing lines, three 525 h.p. engines and generators, etc. $274,545. P.W.A. loan $151,000 and grant $123,545 approved. Garrett Eng. Co., Box 1726, Houston, engrs.

Tex., San Augustine—City, A. E. Rushing, mayor, making plans constructing power plant improvements. $40,000. P.W.A. grant $18,000 allotted. Municipal Engr. & Finance Co., 1109 Mercantile Bldg., Dallas, engrs.

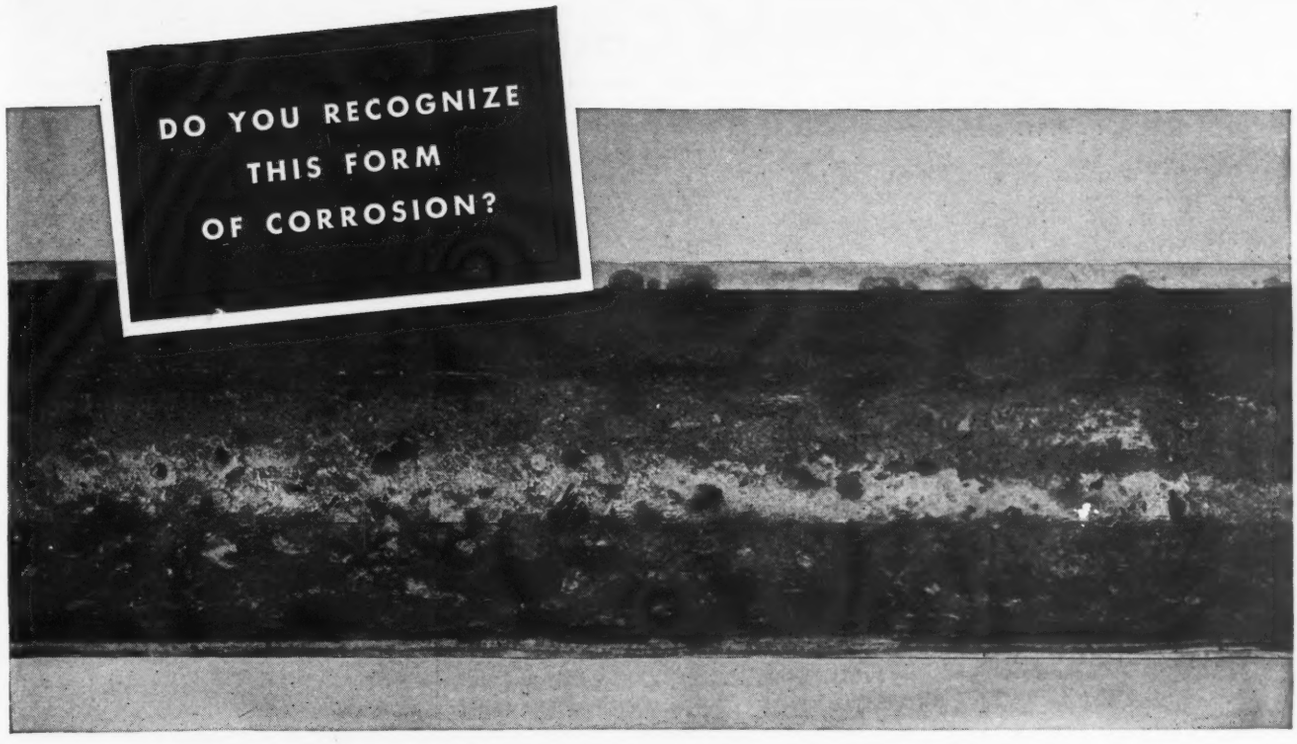
Tex., San Marcos—Guadalupe Blanca River Authority, San Marcos, c/o E. M. Cope, Bd. Director, plans constructing dam and hydro-electric plant on Guadalupe River. $1,079,870. Bonds voted. Fargo Eng. Co., Seguin, engrs.

Tex., Schulenberg — City, G. Nordhausen, mayor, voted bonds, constructing municipal electric light plant and distributing system. $75,000.

Tex., Timpson—City, E. H. Hebert, mayor, voted bonds improving municipally owned light and water plants, both systems will be enlarged and improved. $70,000. P.W.A. project.

Tex., Wylie—City, E. Housewright, mayor, voted bonds constructing municipal electric light and power plant. $49,700. P.W.A. loan $22,050 and grant $26,950 approved.

Alta., Goldfields—Consolidated Mining & Smelting Co., Ltd., W. G. Jewith, genl. supt., making plans constructing power plant. $700,000. S. Gray, c/o owner, engr.



Unretouched photograph of a longitudinal cross-section of a brass condenser tube which failed in service. Magnified 2 X.

DO YOU KNOW HOW TO STOP THIS?

These soft, spongy masses of copper that once were strong, tough alloy—perhaps you have seen them in your own condenser or heat exchanger tubes. Sometimes the copper forms in "plugs"—sometimes it covers the whole tube. But always it spells early failure, time lost, expensive retubing. This is known as *dezincification*—or plug type corrosion.

How can you remedy this and increase your tube life? An analysis of your plant conditions helps to find the answer. Stopping dezincification is not enough—pure copper does that, but it does not stand up under impingement attack, or pitting, or severe general corrosion. What you need is an alloy with the best resistance to *all* the forms of corrosion encountered in your plant. Perhaps the correct alloy for you is Bridgeport's Cuzinal* (Aluminum Brass) or Duronze* IV (Aluminum Bronze).

But before Bridgeport recommends any alloy for your tubes, a condenser engineer will make a thorough study of your conditions—and will consider first cost, to give you the alloy that means longest life with greatest economy. Behind his recommendation is the experience gained through years of successful condenser tube application in every type of plant. Use his experience to solve your condenser problems.

*Trade-name

"Bridgeport" BRASS

BRIDGEPORT BRASS

BRIDGEPORT BRASS COMPANY • BRIDGEPORT, CONN. • ESTABLISHED 1865

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BRIDGEPORT BRASS COMPANY,
Condenser Tube Engineering Dept. C,
Bridgeport, Conn.

☐ I'd like to have a copy of the "Condenser Tube Manual."
☐ I'd like to talk to one of your condenser engineers about my problem.

NAME .....
COMPANY ..... TITLE .....
ADDRESS .....
CITY ..... STATE .....

Current Comment

Scale Removal or Safe-Ending

IN OFFERING further comment on "Scale Removal or Safe-Ending," I want to say that it is fair to assume that the boiler inspector knew what he was doing when he ordered tubes removed and he was within his rights in ordering them safe-ended if they were in condition to warrant the expense. The scale no doubt was of such a nature as to cause serious damage to tubes, and if there was no other way in which scale could be removed, then safe-ending was in order. This is often done in boiler inspection, although at times only enough tubes are removed to permit getting at the scale that accumulates between tubes.

I don't see any reason for limiting the number of safe-ended tubes in a boiler, for if safe-ending isn't expected to do a satisfactory job it shouldn't be done at all. In many railroad shops, whole sets of tubes are safe ended and no serious difficulties encountered. In New York state the only restriction on safe-ending in fire-tube boilers is that "there shall not be more than two circumferential welds in each tube." Re-ending or piecing is further limited by insistence on one of the following methods: (1) electric-resistance butt welding, (2) metallic-arc welding, and (3) by oxy-acetylene welding. In this connection, I wonder why the forging process employed in some railroad shops should not be acceptable also. Surely locomotives are subject to more severe service conditions than most fire-tube boilers in stationary and portable work.

Binghamton, N. Y. C C CARTER JR

What Happened?

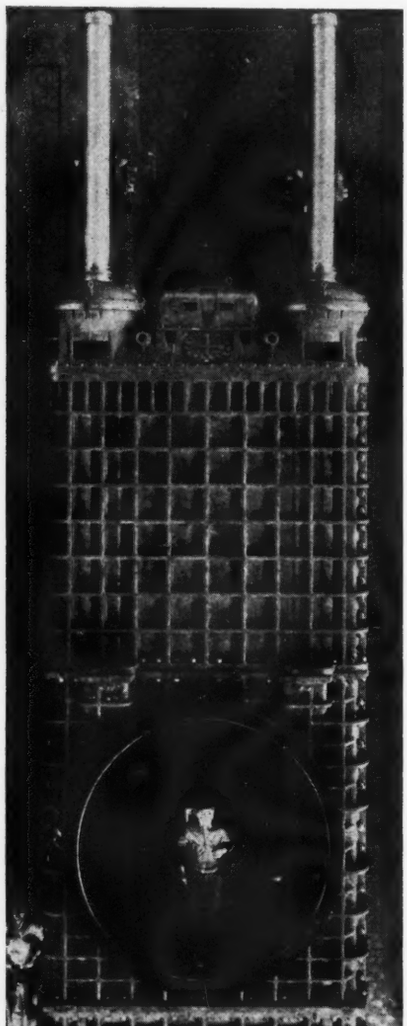
REGARDING the questions in "What Happened" (September *Power*), it appears to me that the boiler was suffering from an insufficient quantity of water, and if a feedwater-flow chart were available it would probably furnish the answer. The difficulty of finding out the exact sequence of events from the operator's memory is well known.

From the cross section of the boiler, it is apparent to me that normal circulation might become upset and still maintain water in the glass. If circulation had a tendency to become unstable at a certain level, a change in steam flow such as occurred at the start of the period might shift the circulation. Normal conditions might return in the same manner, as indicated by the abrupt drop in output at the end of the period, accompanied by increased water flow, or whatever the operator did in addition to blowing down an undetermined amount of water. Unusual deposits of slag or flyash which may have been loosened by blowing down might help to account for non-repetition of the trouble.

I recall an experience of about 12 years ago, with a 15,000-sq ft Stirling boiler which normally delivered saturated steam at 200 lb. Once, for over two hours, it delivered steam at 150-F superheat. After considerable investigation the cause was found to be low water. The boiler operated for a week or two after the trouble, but required considerable rolling of tubes after being removed from service, and the eventual replacement of a number of sagged tubes. The drums suffered no apparent damage.

From this experience, I believe it entirely possible for the top tube bank of the boiler under discussion to have run dry, acting as additional superheating surface, without suffering serious damage. I would be interested to know whether or not a careful inspection of these tubes has been made and if any leaks have since shown up under hydrostatic test.

Beaumont, Texas G R FULTON
Gulf States Utilities Co



SO BIG

Everything about Grand Coulee is so large that comparisons are difficult to make. The gates in the discharge conduits through the dam are no exception; one of the main gates, shown above, weighs 100 tons, is 45 ft high and 12 ft wide. There will be 60 main gates and 60 emergency gates, all 8½ ft in diameter. Hardie-Tynes Mfg Co is building 20 main and 20 emergency gates

Operating Exciter In Parallel

THE ANSWERS to Question No. 2 in September lead me to submit my suggestion for correcting the trouble. The first step in locating this trouble is to see that all connections are correct and then check the compounding of both machines. If it is not the same, shunt the series field winding of the one with too much compounding. If trouble is still apparent, the equalizer connections should be made to have a lower resistance than the series field connections, preferably by running the equalizer directly from one machine to the other with a single-pole switch in the circuit.

When the exciters are operated with a voltage regulator, an equalizing field rheostat should be provided in addition to the main exciter-field rheostat on the exciter which tends to take the load.

Altoona, Pa. A R MARKLAND

More Royal Roads

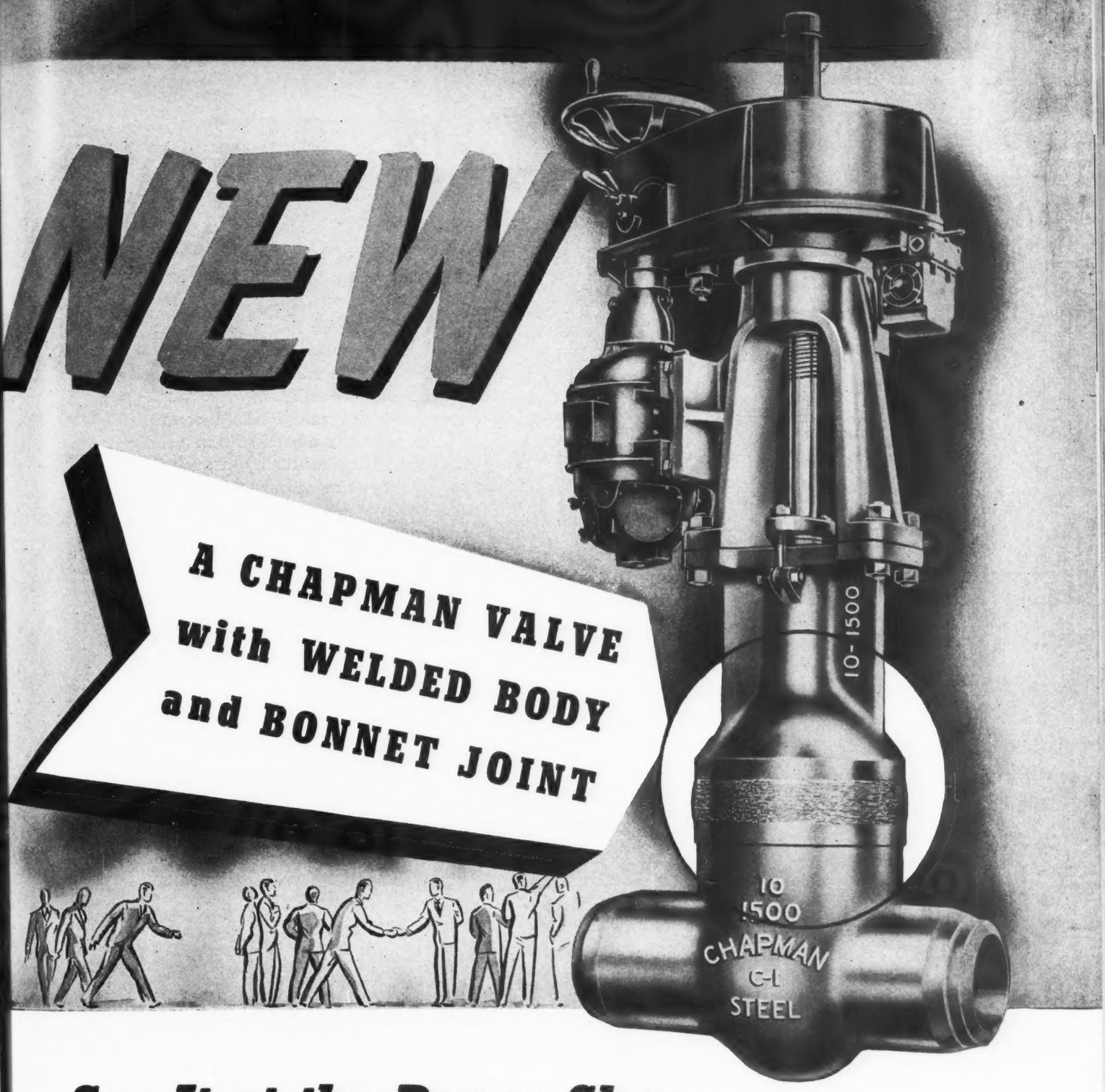
YOUR EDITORIAL ("Royal Road," September *Power*) met with my most hearty approval. Since my graduation from college I have been able to aid several men to higher wages by teaching them some of the fundamentals of mechanics. Three very capable self-made mechanics, none of whom had graduated from grammar school, learned the basic principles of descriptive geometry (blueprint reading to them) in ten 2-hour lessons.

I hope your editorial will encourage other professional men to pass their advantages on to their fellow workers. There is too much tendency to consider uneducated and unintelligent as the same thing. Many uneducated men are capable of understanding and using the practical part of science and mathematics.

For my own part I have gained by passing my knowledge on. I have three men of many years experience in practical work who not only understand my sketches but are anxious to do something to help me. And no man can know everything!

Oakland, Calif. J W DEPOY

NEW



A CHAPMAN VALVE with WELDED BODY and BONNET JOINT

See It at the Power Show...

This year—at the Power Show—Chapman presents its outstanding achievement in valve design and construction.

Designed for pressures up to 2500 lbs. at temperatures to 1000°F., the new Chapman Valve features a *welded body and bonnet joint.* This construction eliminates extremely heavy flanges and bolting, and the possibility of gasket failures due to high pressures and temperatures now usual. Seat rings are screwed in and seal welded. Castings are given a hydrostatic test and the body a thorough seat test before assembly; after welding the finished valve is given a kerosene test to its full test pressure. Body and bonnet weld are checked by Gamma Ray.

All resources of Chapman's engineering, metallurgical and scientific experience are combined to make this valve another outstanding example of Chapman's leadership.

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***SEE** OUR DISPLAY AT THE POWER SHOW*

BOOTHS 46-47

Two valves will be shown:—a 10″ 1500 lb. cast valve, and an 8″ 2500 lb. valve with body and bonnet both machined from solid forged ingots.

CHAPMAN POWER PLANT VALVES

Craftsman . . .

AN OLD FRIEND stopped in to see a cabinetmaker, to find him hard at work under an almost-completed table. "Well," said the friend, "What in the name of time are you doing under there?"

"Just smoothing up a rough spot," said the cabinetmaker.

"But you're wasting your time; nobody will ever know it's there," objected the friend.

"*I* will!" said the cabinetmaker quietly.

He was doing the job right, whether or not he got paid, because he had the instinct of craftsmanship. For most of us today, some machine does most of our thinking, so any urge we have to be craftsmen is expressed in "million-dollar" model engines, airplanes and so on that we make at home. On those jobs, no thought of pay or time enters, so we make certain that every little piece is exactly right, that it fits like the parts of the fabulous one-hoss shay.

But, every so often, somebody in business turns out a job that exhibits real craftsmanship. I think the Handbook of Hookups in this issue is one example. Hookups always have been diagrams, full of complicated pressure and temperature figures, crisscrossed heat flows, and elaborate ways of showing the difference between steam and water. Like the buggy users, engineers, have gotten used to these diagrams, more or less blind to the fact that the standard hookup is a confoundedly difficult thing to understand. And nobody has ever done anything much about it.

Nobody, at least, until now. Because the editors of *Power* have done something about it, something that makes the whole business a heck of a lot simpler. I suspect that when they started, they were at heart a little sorry for themselves — they probably see more hookup diagrams in a year than anybody else — and that that generated the idea. But they did get somewhere in solving the problem for all of us.

The other day when he showed me the finished job, I asked Phil Swain whether he thought all the work was necessary. "Well," said Phil, "I don't know. We might have been able to get a partially similar result by drawing hookups in three dimensions, but to get the whole thing we were after we felt we had to go in for actual models. For example, we could have made wooden units, connected by spaghetti tubing or something similar. But they wouldn't have photographed as well. And we could have taken regular photographs, but we felt that we ought to kill perspective and get parallel lines parallel. All through, there were alternate ways of doing things, but we felt that the ways we chose were the right ways, even though they took infinitely more time."

There's the craftsman speaking in that last sentence, . . . "we . . . chose the right ways, even though they took infinitely more time." But I think the added hours put in in thinking, planning and working stands out all over the finished job, obvious in the indication that this is one of the greatest things *Power* has ever done for its readers and for the power field in general. I only wish that I might have been an editor for the last year, so that I could stand beside them now in the consciousness and pride of a difficult job well done.

George Edwards

Engineer

GUIDE POSTS TO BETTER DIESEL PERFORMANCE

DIESEL ENGINE PARTS

PART	KEY LETTER
Base	A,B,L,X
Bed Plate - heavy engine	L,N
Bed Plate - light engine	A,B,X
Cams	H,J,Q
Cams - heavy engine	G
Camshafts - heat treated	Q,S
Connecting Rod Shoes, Guides	C
Cooling Water Circulating Pump Body	A,R,T
Cooling Water Circulating Pump Impeller	A,R,T
Crankcase	A,B,C,L,X
Crankshaft	S
Cylinder Blocks, Bodies, Frames - heavy engine	C,D,L
Cylinder Liners, for use with above	B,C,M
Cylinder Blocks, Bodies, Frames - light engine	A,E,K
Cylinder Liners, for use with above	A,E,K,R
Cylinder Blocks, Bodies, Frames - high strength	B,R
Cylinder Heads - heavy engine - high strength	M
Cylinder Heads - medium engine	L,P
Cylinder Heads - light engine	A,E,F
Cylinder Heads - light engine - high strength	N
Cylinder Liners - light and medium engines (sand cast, heat treatment optional)	E,P
Cylinder Liners - centrifugally cast, heat treated	A,E,P,R
Cylinder Liners - For use with aluminum blocks and pistons	T
Flywheel	A,B,X
Frame castings - heavy engine	A,B,P,X
Fuel Oil Pump Body	A,R
Housings - heavy engine - see also Frame castings	A,B,P,X
Lubricating Pump Body	A,R
Manifolds	E,P,F,G
Manifolds - water cooled	E,T
Oil Cooler Body	E,T
Pistons - heavy engine	C,M,P
Pistons - heavy and medium engines - high strength	B,N,P
Pistons - light engine	E,K
Piston Crowns - inserts in aluminum pistons - light engine	T
Piston Rings - heavy engine - single cast	A,L,K
Piston Rings - heavy engine - pot cast	B,D,E
Piston Rings - heat treated	R,S
Piston Rings - medium engine - pot cast	A,K
Piston Rings - light engine - pot cast	K,R
Timing Gears	A,K,R
Turbo-Blower Casing	A,K,R
Valves - Cooled cast on head	E,G,T
Valve Guides	E,T
Valve Seats - for use with aluminum heads	T
Valve Seats - heavy engine	E,L

RECOMMENDED COMPOSITIONS AND TYPICAL MECHANICAL PROPERTIES OF NICKEL CAST IRONS FOR DIESEL ENGINE PARTS

KEY LETTER	CHEMICAL COMPOSITION						TYPICAL RANGE OF MECHANICAL PROPERTIES	
	TOTAL CARBON	SILICON	MANGANESE	NICKEL	CHROMIUM	MOLYBDENUM	TENSILE STRENGTH, p.s.i.	BRINELL HARDNESS
A	3.10/3.30	1.40/1.80	0.50/0.80	1.25/1.75	-	-	35,000/40,000	200/240 (7)
B	2.75/3.00	1.30/1.70	0.60/0.90	1.50/2.00	-	-	50,000/60,000	220/260
C	3.00/3.20	1.00/1.40	0.50/0.80	1.00/1.50	-	-	36,000/40,000	200/260
D	3.00/3.20	0.90/1.30	0.50/0.80	1.75/2.25	-	-	38,000/44,000	200/260
E	3.10/3.30	1.70/2.10	0.50/0.80	1.50/2.00	0.40/0.60	-	36,000/40,000	210/250 (7)
F	3.20/3.40	1.90/2.30	0.50/0.80	1.00/1.30	0.40/0.60	-	33,000/38,000	200/240
G	3.10/3.50	1.50/1.80	0.50/0.80	1.75/2.25	0.60/0.75	-	36,000/42,000	220/280
H	3.00/3.20	1.00/1.40	0.60/0.90	2.75/3.25	0.40/0.60	-	45,000/55,000	260/330 (7)
J	3.00/3.20	0.70/0.90	0.60/0.90	1.75/2.25	0.90/1.10	-	35,000/40,000	280/350 (6)
K	3.00/3.30	1.70/2.20	0.50/0.80	0.75/1.25	0.15/0.30	-	33,000/38,000	170/220
L	3.05/3.30	1.00/1.40	0.50/0.80	1.00/1.75	0.30/0.60	(5)	36,000/42,000	220/260
M	2.90/3.10	1.00/1.90	0.60/0.90	1.00/1.50	0.25/0.35	(5)	40,000/50,000	210/260
N	2.70/3.00	1.50/1.90	0.60/0.90	1.75/2.25	0.20/0.40	(5)	50,000/60,000	220/260
P	3.00/3.25	1.30/1.75	0.60/0.90	1.35/1.50	0.30/0.50	0.30/0.60	40,000/50,000	200/260 (7)
Q (3)	3.10/3.40	2.10/2.40	0.50/0.75	0.20/0.40	0.75/1.00	0.40/0.60	50,000/55,000	260/300 (7)
R	3.10/3.30	2.00/2.40	0.50/0.80	1.25/1.75	0.10/0.30	0.30/0.50	45,000/55,000	220/280
S	2.60/3.10	1.90/2.50	0.65/1.00	1.25/1.75	-	0.60/1.00	60,000/70,000	260/300 (7)
T	2.30/3.00	1.00/2.00	1.00/1.50	13.00/16.00 (4)	2.00/5.00	-	22,000/30,000	140/180
X	3.00/3.50	1.00/2.20	0.50/0.80	-	-	-	20,000/30,000	140/180

Foot-notes: (3) Made by Campbell, Wyant and Cannon Foundry Co. (4) Also includes 5.00/7.00% copper. (5) Optional. (6) The chilled surface hardness will be approximately 550 Brinell. (7) Heat treatment optional.

With economical Diesel power being applied to many new uses, this summary of Diesel engine materials in actual service can be helpful as a guide and comparison for your specifications. These Nickel cast irons have a background of successful performance under many conditions.

Because Diesel engines vary widely in size and type, more than one Nickel cast iron composition is suggested and your choice will depend upon the size and service requirements of your engine.

Since earliest days of Diesel development, it has been Nickel's privilege to aid in the development of stronger, longer-wearing materials which withstand higher pressures and higher temperatures. Consultation regarding the uses of Nickel is invited.

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Engineers' Books

(*Continued from page* 120)

marizes activities of 1937—total kwhr production, construction, transmission and distribution facilities, number of customers, etc.

ARC WELDING AND HOW TO USE IT (1938). *Published by Hobart Bros, Hobart Square, Troy, Ohio. Price $1.50 in U. S., $2.00 in Canada and foreign countries.*—Information on development of arc welding, weldability of metals, welding lessons. Describes and discusses modern welding equipment. 320 illustrations.

STANDARD CODE FOR TESTING STOKER-FIRED STEAM-HEATING BOILERS (1938). *Published by Stoker Manufacturing Assn, 307 N Michigan Ave, Chicago, Ill. Single copies free; 5 cents per copy for bulk orders.*—Standard method for conducting and reporting tests to determine heat efficiency and performance characteristics.

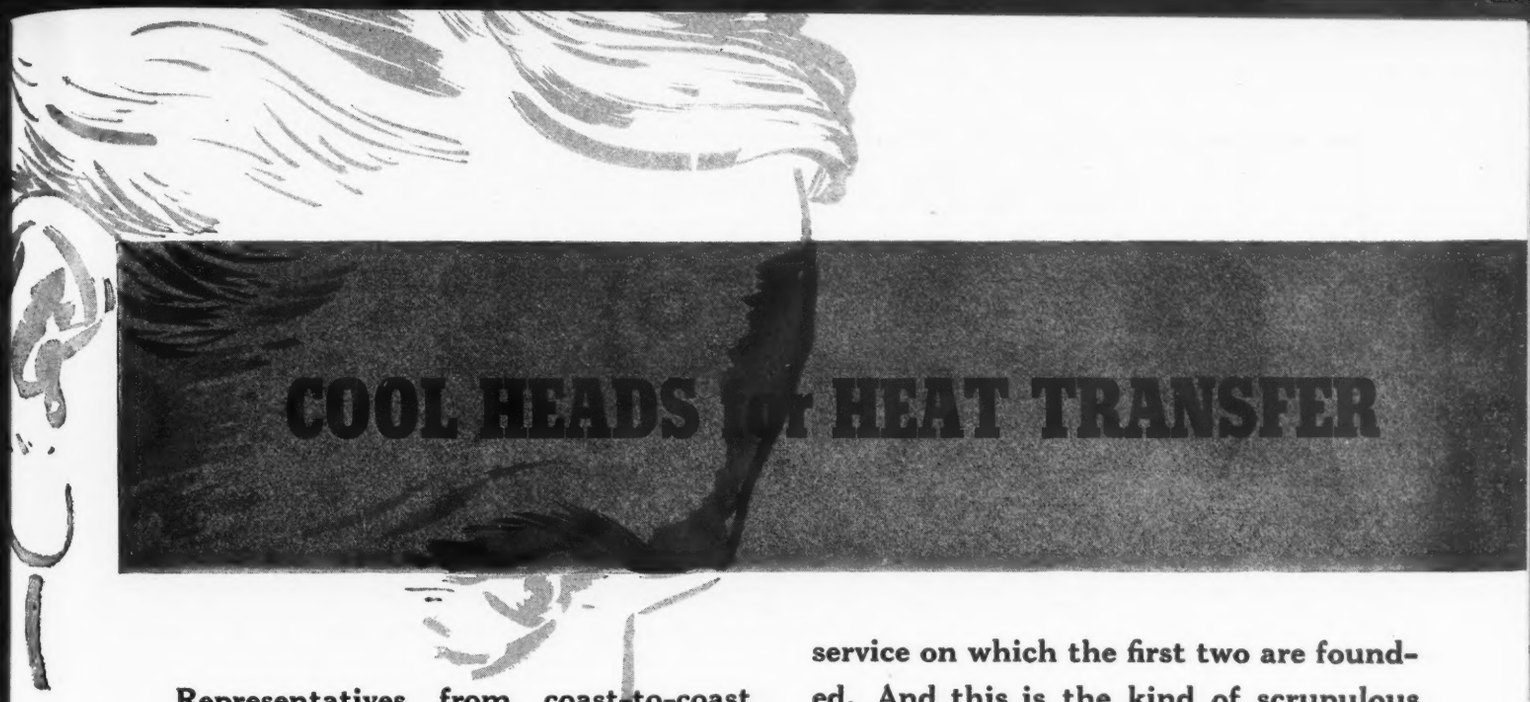
DESIGN OF SWITCHHOUSES FOR GENERATING STATIONS AND TRANSMISSION SUBSTATIONS (1938). *Published by Edison Electric Institute, 420 Lexington Ave, New York, N. Y. Price 40 cents to members and their employees, $1 to non-members in U. S. A.*—Presents information on basic design of switchhouses operating at voltages between 11 and 24 kv. Includes reports on specific projects of 11 operating companies, covering 12 generating stations and one transmission substation.

STANDARD TEST CODE FOR CENTRIFUGAL AND AXIAL FANS (3rd Edition—1938). *Published by National Assn of Fan Manufacturers, 5-208 General Motors Bldg, Detroit, Mich. Price 25 cents.*—Clarifies definitions, covers the several methods of testing as applied to various types and arrangements of fans, etc.

EFFECT OF CITY WATER AND SEWERAGE FACILITIES ON INDUSTRIAL MARKETS (1938). *Published by Bureau of Foreign and Domestic Commerce, Washington, D. C. Price 10 cents.*—Surveys available water supply in metropolitan centers of the U. S., and its relation to market for air-conditioning and other industrial equipment. Data on raw-water supply, delivery capacity of present plants, expansion of delivery possible with present equipment, etc.

DIESEL OPERATION—FUEL AND LUBRICANTS (1938). *Published by The Texas Co, 135 E 42nd St, New York, N. Y. Available on request.*—Presents properties of lubricating oil and the tests for measuring them, problems of bearing and cylinder lubrication, and factors involved in selecting lubricating oil. Includes a trouble-shooting guide and tables of useful data on oil characteristics.

SELECTION OF LUBRICANTS IN MECHANICAL REFRIGERATION (1938). *Published by The Texas Co, 135 E 42nd St, New York, N. Y. Available on request.*—Presents brief outline of refrigeration theory, and refrigerant properties. Selection of oils for ammonia and carbon-dioxide systems is considered as well



COOL HEADS for HEAT TRANSFER

Representatives from coast-to-coast keep Scovill informed of heat transfer conditions, problems, and solutions. Working with you in the field, as they do, their approach to any condenser tube situation is cool and practical, as well as theoretical. Frequently they can base a method of approach on Scovill's Heat Exchanger Tube Manual, a book that contains, as far as we know, a larger amount of tube data than any other ever published. Largely, it was built on the experiences Scovill men had while working with you.

And if your company is a Scovill customer, you may expect regular visits from a Scovill man. That is a part of this company's service . . . a maintenance of Scovill interest after the job is done.

Thus, Scovill provides you with two services. First of these is Engineering data. Second is Engineering on-the-spot, at your command. But there is a third service on which the first two are founded. And this is the kind of scrupulous Engineering we put into production.

We wish we could tell you in this space of the exactness of control that goes into extrusion, hot piercing, and cup-drawing processes of producing Scovill tubes. But we suggest you send for a Scovill Condenser Tube Booklet that will give you a clear picture of this, as well as other important information. Ask for *Scovill Condenser Tubes*, addressing Scovill Manufacturing Company, 13 Mill Street, Waterbury, Connecticut.

A New England power company experienced tube failures in a new condenser after six months operation and complete failure of all tubes in nine months. A different material increased the tube life somewhat, but was not considered satisfactory. Scovill Admiralty Tubes were then employed for retubing. Since that time, 15 years ago, there have been no tube failures, although for the past five years the condenser has been used only in reserve.

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Masters of Metal

Scovill Condenser Tubes

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NEXT TIME YOU MAKE REPLACEMENTS INSTALL THE NEW "COOK'S *Tinized*" RINGS!

These piston rings have got something that has long been needed—a coating of NON-SCUFF ANTI-FRICTION METAL over the *entire* wearing surface.

This soft, friction-reducing metal, works to a perfect seat in double-quick time without risk of damaging the existing cylinder glaze—and with far less wear on both rings and cylinders.

In addition, there is less wear and longer life after the break-in process because, underneath the metal coating are *standard* COOK'S GRAPHITIC IRON Piston Rings long famous for their superior wear-resisting and wear-retarding qualities, and their unfailing dependability.

A trial will convince engine and compressor operators that COOK'S "TINIZED" Rings truly are the ultimate in ring performance and economy. *BULLETIN 385-P* gives complete details. Write for a free copy today.

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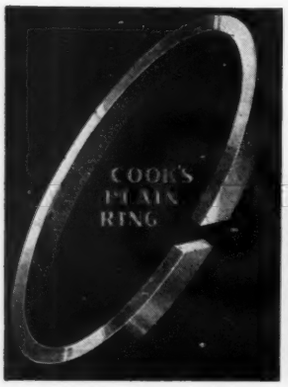

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COOK'S GRAPHITIC IRON
*NON-SCUFF—QUICK-SEATING—ANTI-FRICTION METAL FACED
Piston Rings

as notes on the lubrication of electric refrigerators and air-conditioning equipment.

PROGRAM AND PROGRESS—PENNSYLVANIA ANTHRACITE COAL (1938). *Published by Anthracite Industries, Inc, Chrysler Bldg, New York, N. Y., with the cooperation of this organization's Multiple Industrial Fellowship at Mellon Institute, University of Pittsburgh. Available on request.*—Outlines extensive program of technical and educational work in progress on modern methods of using anthracite, and presents facts about the magnitude of this industry.

POWER REQUIREMENTS IN ELECTROCHEMICAL, ELECTROMETALLURGICAL AND ALLIED INDUSTRIES (1938). *Published by Federal Power Commission, Washington, D. C. Price, including maps, charts and tables, $1.*—Estimates future power requirements in these industries compared to past consumption and predicts future sources of power.

CREEP DATA ON WROUGHT AND CAST CARBON AND ALLOY STEELS (1938). *Published by the American Society of Mechanical Engineers, 29 West 39th St, New York, N. Y. Price $12*—First comprehensive assembly of creep data includes stainless steels, cast iron and some non-ferrous metals. Over 900 pages, includes 430 sheets of test data, 270 graphs and 73 tables. Limited edition.

REVUE OF CENTRAL STATIONS (1938)—(L'evolution des Grandes Centrales Thermiques). *Published in French by Science et Industrie, 29 Rue de Berri, Paris, France. Price 45 francs.*—A comprehensive review of European central-station practice covering both steam and electrical systems.

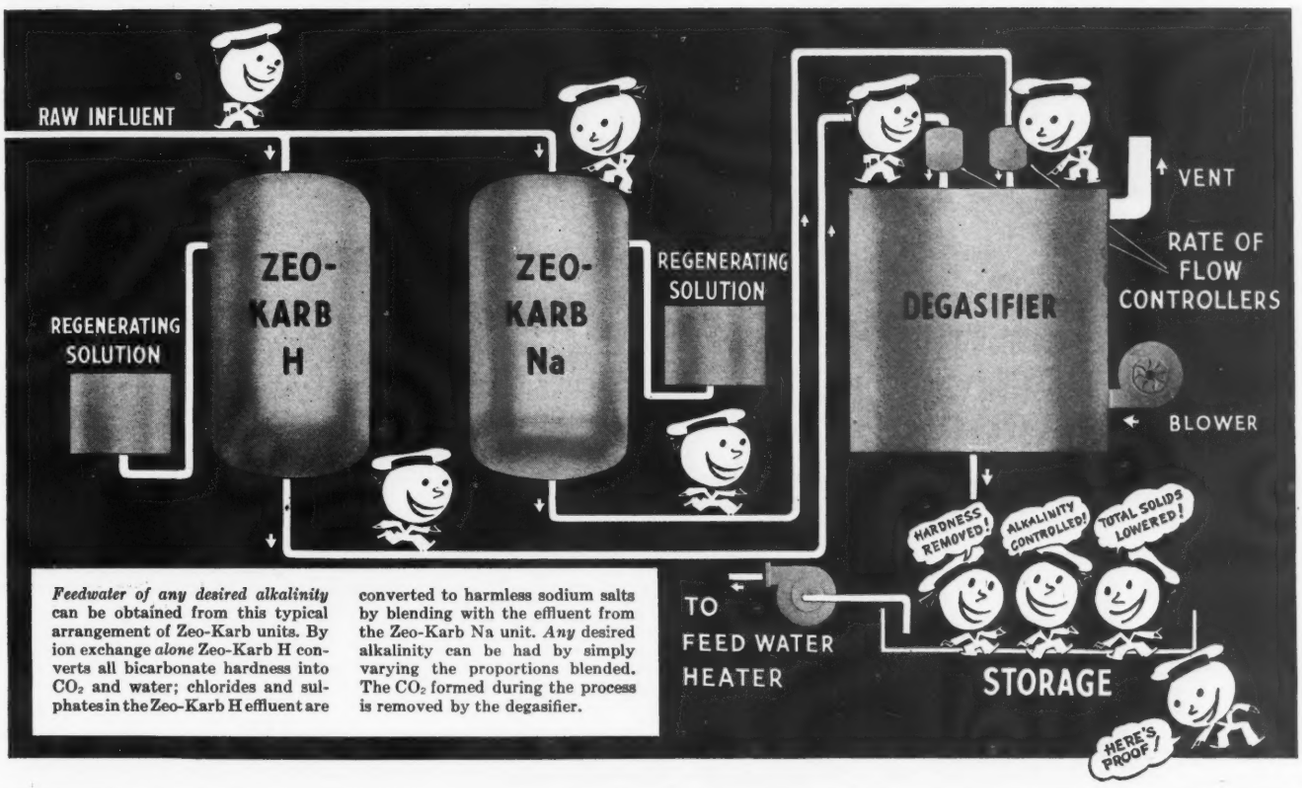
SYSTEMATIC LOCATION OF DIESEL-ENGINE TROUBLES (1938). *By Victor W Page. Published by Norman W Henley Publishing Co, 2 West 45 St, New York, N. Y. A 2-color wall chart 25x38 in., price $0.50.* For automotive diesel men, this chart shows engine parts, lists troubles likely to occur, symptoms of each, and indicated remedies.

PAPERS PRESENTED AT THE SHORT COURSE IN COAL UTILIZATION (1938). *Published by Engineering Experiment Station, University of Illinois, Urbana, Ill. Price 50 cents.*—Includes papers on stoker installation and servicing; smoke, dust and air pollution; dustless treatment of coal; presented at short course held at University of Illinois, May 1937.

PRESSURE LOSSES RESULTING FROM CHANGES IN CROSS-SECTIONAL AREA IN AIR DUCTS (1938). *By Alonzo P Kratz and Julian R Fellows. Published by Engineering Experiment Station, University of Illinois, Urbana, Ill. Price 65 cents.*—Presents information for users and designers of air-duct systems, giving data on pressure losses resulting from changes in cross-sectional area that are essential in evaluating total resistance to flow of air, an estimation of which is required for proper selection of fans and motors.

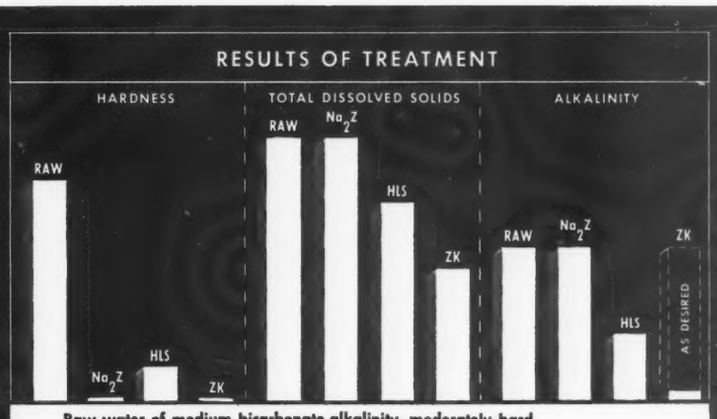
WATERWORKS OWNERSHIP IN THE UNITED STATES (1938). *Published by Burns & McDonell Engineering Co, Kan-*

Here's the Hook-up on Permutit Zeo-Karb



Feedwater of any desired alkalinity can be obtained from this typical arrangement of Zeo-Karb units. By ion exchange *alone* Zeo-Karb H converts all bicarbonate hardness into CO_2 and water; chlorides and sulphates in the Zeo-Karb H effluent are converted to harmless sodium salts by blending with the effluent from the Zeo-Karb Na unit. *Any* desired alkalinity can be had by simply varying the proportions blended. The CO_2 formed during the process is removed by the degasifier.

Here's the Check-up on what it does for feedwater treatment



Raw water of medium bicarbonate alkalinity, moderately hard.
LEGEND: RAW=Raw water; Na_2Z=Sodium zeolite; HLS=Hot lime soda
ZK=Zeo Karb H and Na

Does Your Plant Need Zeo-Karb?

Zeo-Karb is a carbonaceous zeolite and, therefore, non-siliceous. It is called Zeo-Karb Na when operated on the sodium cycle — Zeo-Karb H when operated on the hydrogen cycle. When operated on both the hydrogen and sodium cycles, according to the hook-up shown above, it is better than any other process for: 1. Preventing Scale. 2. Lowering Alkalinity. 3. Reducing Total Dissolved Solids.

But is Zeo-Karb the best, most economical feedwater treatment for you? Perhaps Permutit's Hot Lime Soda or some other specialized Permutit service would be more suitable for your plant. That is a problem you and the Permutit engineer can best solve together. Whether or not you plan new feedwater equipment, read Permutit's authoritative booklet on Zeo-Karb. It's free . . . address The Permutit Company, Dept. A , 330 West 42nd St., N. Y.

ZEO-KARB
ZEOLITE
HOT LIME SODA
LIME ZEOLITE
INTERNAL

Well-known Plants using Zeo-Karb
(names on request)

USER	LOCATION	BOILER PRESSURE
Industrial Steam Plant	Pennsylvania	600 lb./sq. in.
Smelting Plant	New Jersey	450 lb./sq. in.
Paper Pulp Mfr.	South	400 lb./sq. in.
Large Public Utility	Midwest	475 lb./sq. in.
Paper Manufacturer	Michigan	615 lb./sq. in.
Paper Manufacturer	Wisconsin	650 lb./sq. in.

Permutit
The Water Conditioning Headquarters
over 25 years

when ENGINEER meets ENGINEER

The answer is—

HENSZEY CONTINUOUS BLOWDOWN

That's because this remarkable system holds the concentration of the boiler water at a pre-determined proper degree—eliminating the common troubles of priming, foaming, formation of scale and carry over. This complete, automatic control of boiler water impurities can be accomplished *without heat loss*—a decided economy factor.

Is it no wonder then—when Engineer meets Engineer, the answer is "Henszey". It will pay you to further investigate the advantages of this system. Send in for complete detailed literature.

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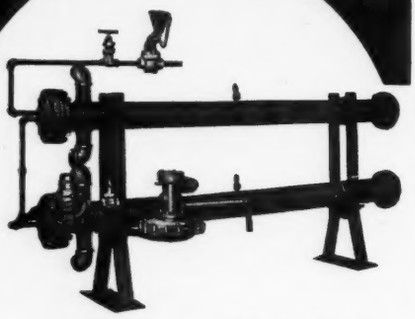

Feed Water Meter
Here is a meter that does a real job of accurate measuring regardless of heat or dirt in the water. Perhaps you have a special liquid measuring problem in your plant that this meter can solve for you. Ask us about it.

Flow Indicator
Here is another item that was primarily designed for use in the Henszey Blowdown System, but has found uses in other fields. Indicates rate of flow of steam, water or other fluids. Special model meets all sanitary requirements for milk and other food fluids.

Add to the Roster

- The Texas Company
- Armstrong Cork Co.
- Socony Vacuum Corp.

Henszey Systems are now being installed in these nationally known companies.

HENSZEY

BOILER WATER CONCENTRATION CONTROL SYSTEMS

sas City, Mo. Available on request.—A record of 2868 cities, 3000 population and over, as of Jan 1, 1938, giving a survey of water-property ownership by states and determining population served in each state by municipal and by private properties. Also gives information on rates, taxes, bonds, etc.

Power Lines

(*Continued from page* 124)

liard Corp, Elmira, N. Y., in the sale of oil reclaimers in that territory. Mr Hadley has been associated with power plants for many years, having been with McIntosh & Seymour for 16 years and Worthington Pump & Machinery Co for 3 years in erecting diesel plants in the Middle West.

CLAYTON S COGGESHALL has been appointed manager of the Turbine Div, Central Station Dept of General Electric Co, succeeding the late Robert B Beale. Mr Coggeshall has served in the capacity of general assistant to Mr Beale since March of this year. Prior to that time, he was manager of sales of the Lynn River Works turbine section.

HERMAN R LARSON was recently named central district service manager for Westinghouse Electric & Mfg Co, with headquarters at the Homewood Works. With the exception of one year, 1920, when he was in the Generator Test Div, Mr Larson has been continuously in the Service Office, and before that he was service representative and manager at Johnstown, Pa., Cleveland, Ohio, and Detroit, Mich.

VICTOR A HANSON, vice-president and chief engineer of the Power Transmission Council, Boston, Mass., has resigned to accept a position with Whitney Chain & Mfg Co, Hartford, Conn.

THE GREATER NEW YORK ASSN, National Association of Power Engineers, awarded its Robert Grimshaw Medal for 1938 to Patrick Cassidy "in recognition of his efforts to promote legislation furthering the interests of power engineers." This medal is awarded annually by the Assn to commemorate Robert Grimshaw's distinguished services in steam engineering.

J W MERIAM, for the past 24 years vice-president and secretary of Lincoln Electric Co, Cleveland, Ohio, has retired at the age of 60. A F Davis, vice-president, was elected secretary.

GEORGE BERNAUER, formerly chemical engineer of the Milwaukee Sewage Commission, has returned to Milwaukee as resident chemical engineer for W H & L D Betz, Chemical Engineers & Consultants. Also, J A DeWinter, formerly chemical engineer with Public Service Co of Indiana, has been appointed Betz engineer for the Detroit area.

J TIMOTHY O'HARA, formerly with Amthor Testing Instrument Co, has organ-

4 *new* BULLETINS available

No. 132: "POWER by SMITH" for medium sized developments.
No. 137: HOISTS, GATES and VALVES for water control.
No. 138: IMPULSE TURBINES.
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FOR more than 60 years, "POWER by SMITH" and Water Power Problems have had one and the same significance to Power Plant owners and operators. During this time we have solved many extremely difficult hydraulic problems with equipment developing millions upon millions of horsepower.

Out of this wealth of knowledge and practical experience have come these four new Bulletins, dealing with the necessary machinery for almost every conceivable problem of water control and water power development.

Take advantage of this opportunity to become posted on late developments in the field of hydraulic power and engineering. Send for copies of these Bulletins — today. Our facilities, the results of our extensive research and the consultation of our engineers, are at your disposal for such assistance as your individual problem may require.

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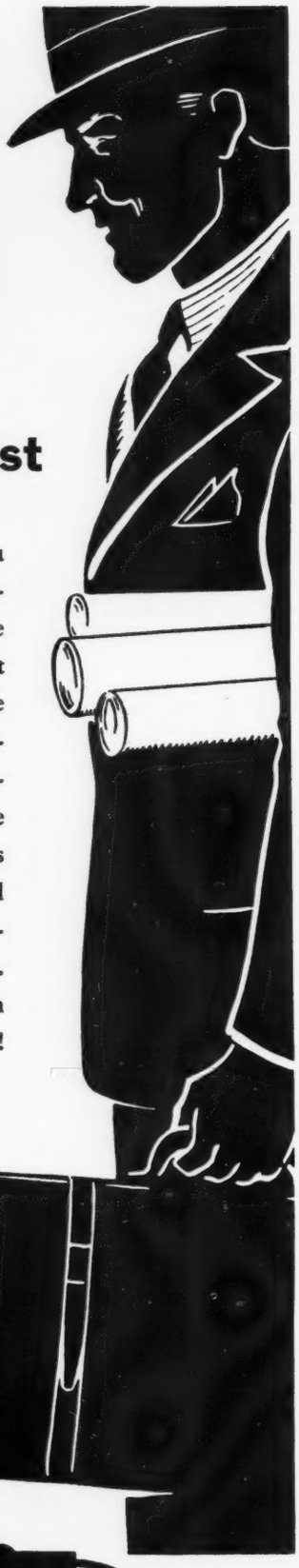


He's a Water Treatment Specialist

"THE SCAIFE MAN" is a good man for you to meet and know at any time—but particularly when you have a really bothersome boiler feed water problem to discuss. Let him shoulder your difficulty! His acute knowledge of proven techniques in handling power plant water has been demonstrated in successful cooperation with the largest as well as the smallest plants . . . his readiness to serve you is immediate . . . and back of him are the full resources of a long-established leader in water conditioning.

A consultation does not obligate you in any way. Call in The Scaife Man today!

SCAIFE

MANUFACTURES FOR THE POWER INDUSTRY:

Water Softeners: Hot Lime Soda . . . Cold Lime Soda . . . Sodium Zeolite . . . Hydrogen Zeolite. **Water Filters:** Gravity . . . Pressure. **Continuous Blowdowns; Zeolite Minerals; Filter Refills.**

Let us quote you!

WM. B. SCAIFE AND SONS CO.

General Office, Laboratory and Works—OAKMONT, PA.

(Pittsburgh District)

Branch Offices in Principal Cities

ized his own sales agency to deal in testing instruments for rubber, wire, steel and allied instruments. Offices are at 620 E 43rd St, Brooklyn, N. Y.

W H RODGERS has been appointed engineering manager of Westinghouse Electric & Mfg Co's Eastern District. He succeeds R E Powers, who was made Northwestern District service manager. Mr Rodgers joined Westinghouse's Central Station Engineering Section in 1922, and since then has worked on electrical supply and distribution problems.

H A S HOWARTH, who has been associated with Albert Kingsbury and his company for 24 years, has formed Howarth Pivoted Bearings Co, Ontario and 23rd Sts, Philadelphia, Pa. This company will manufacture a complete line of thrust and journal oil-film bearings.

OBITUARIES

EVERETT FRANK DOWST, 50, prominent New England power engineer, died in Manchester, N. H., Oct 13. He became a partner in the engineering firm of Gay & Dowst in Manchester in 1920, and later acquired full interest.

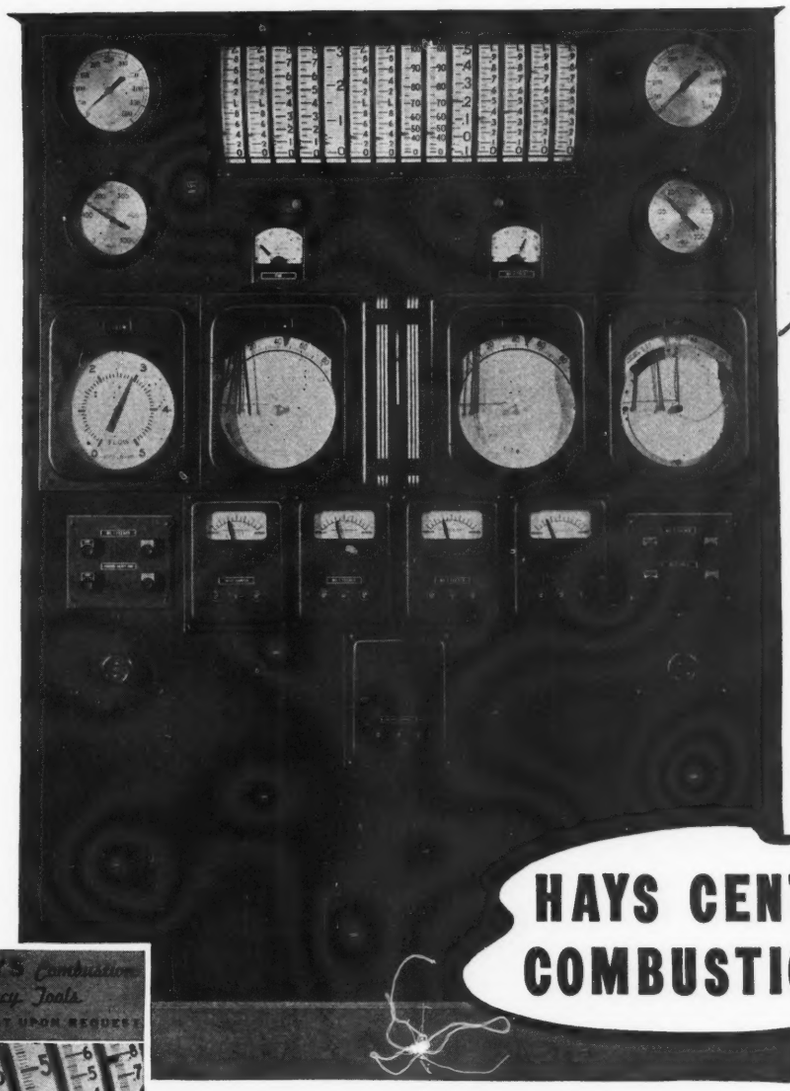
FRANK P MEYER, 55, a director of Pittsburgh Piping & Equipment Co, Pittsburgh, Pa, died Oct 10. A cold that developed into pneumonia was responsible for his death. Mr Meyer joined Pittsburgh Piping at the age of 20 when the company was founded in 1903, and advanced to the position of chief engineer. In 1928, he was elected a member of the board of directors, and the first of this year was made manager of the Engineering Dept.

S CLIFFORD JACOBY, 41, chief system operator and electrical engineer of the Montaup Electric Co, Fall River, Mass., died at Fall River, Oct 20. Mr Jacoby was well known among operating plant engineers in New England, and was a former secretary of the New England System Operators Club as well as a member of the Providence Engineering Society and the AIEE. William B Carnie, senior system operator, has been named to succeed Mr Jacoby.

JOHN D STILES, 83, former manager and director of Jenkins Bros, valve manufacturers, Boston, Mass., died at Stoneham, Mass., Sept 14. He was born in Strafford, N. H., and retired in 1928 after 40 years with the Jenkins organization.

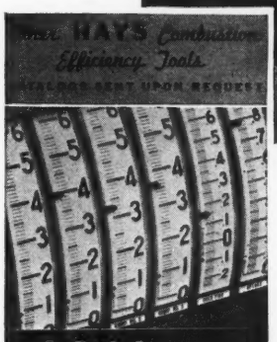
THOMAS ELLIOTT, 75, died at Cleveland, Ohio, Sept 25, of a heart ailment. Mr Elliott was for a number of years connected with electric light, power and street railway companies in the South and Middle West, having constructed power plants in Atlanta, Cincinnati and various other cities in Ohio and Indiana. He was first employed by the Reading Railroad Co in its Mechanical Dept, and later was president of the Cincinnati Car Co.

JAMES F TREAT, 51, for the past 11 years chief engineer of the Pittsfield (Mass.) Electric Co, died at a Boston

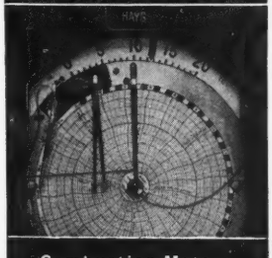


Lower
STEAM COST
More Perfect
COMBUSTION
Steadier
POWER
through

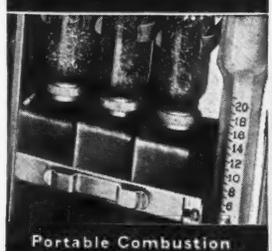
HAYS CENTRALIZED COMBUSTION CONTROL



Draft Gages
all types and ranges



Combustion Meters



Portable Combustion
Testing Instruments

HAYS centralized automatic combustion control is adapted to steam power plants of all sizes burning all types of fuel. Its benefits are positive—steam is produced at the lowest possible cost, it is held at a constant pressure regardless of load. Combustion is maintained at its highest efficiency, which means less smoke, cleaner boiler tubes, better heat absorption, lower maintenance.

Hays is the one truly CENTRALIZED control system—ALL of the control units and measuring instruments are contained in one panel. Here is concentrated all of the information necessary for an intelligent understanding of what is going on inside furnace, boiler and steam lines. And from this central panel the entire control system or any individual part of it may be operated manually.

The Hays system is extremely sensitive—responding to ounces of change in steam-header pressure. Electrically operated the response is instantaneous —corrections made with no lagging.

Hays Centralized Combustion Control is offered through capable engineering organizations located in all the principal cities of the U. S. A. and Canada. Correspondence is invited. Send for 40-page catalog.

The HAYS CORPORATION
SINCE 1901
COMBUSTION INSTRUMENTS AND CONTROL
MICHIGAN CITY, INDIANA, U.S.A.

SEE THIS EQUIPMENT AT OUR BOOTH NO. 48, NEW YORK POWER SHOW

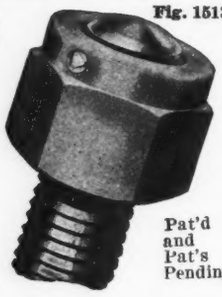
VIBRATION can't be entirely eliminated in POWER PLANTS

. . but you can control it with UNSHAKO

The Nut that can't shake loose

Diesels, reciprocating engines, pumps, conveyors, generators, stokers, ash-handling equipment . . . all these will vibrate and eventually nuts may shake loose unless properly protected or constantly gone over. The easiest way is to install "Unshako" Self-Locking Nuts. Let their built-in locking rings stand guard for you and keep your equipment tight always. They won't fail you.

Fig. 1513



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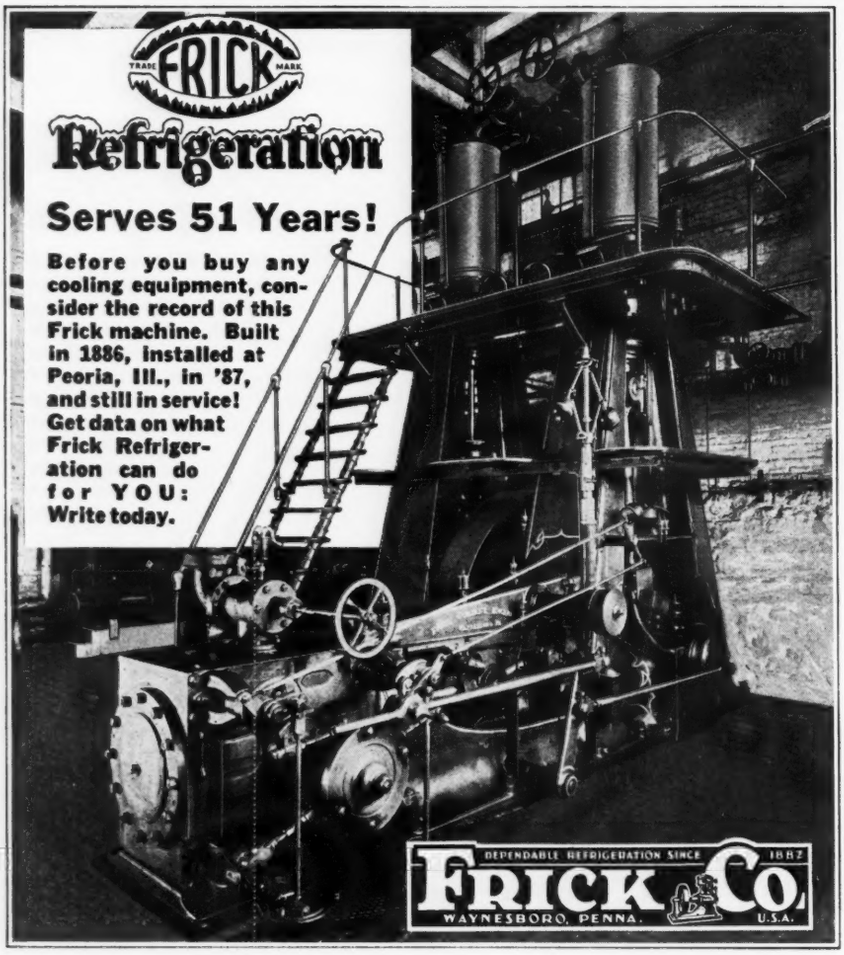
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Refrigeration
Serves 51 Years!
Before you buy any cooling equipment, consider the record of this Frick machine. Built in 1886, installed at Peoria, Ill., in '87, and still in service! Get data on what Frick Refrigeration can do for YOU: Write today.
DEPENDABLE REFRIGERATION SINCE 1882
FRICK CO.
WAYNESBORO, PENNA. U.S.A.

hospital Sept 28. He was born in Saltersville, R. I., and entered the employ of the Pittsfield utility in 1903, working in the steam plant in various capacities until he succeeded his father, Fred Treat, as chief. Mr Treat was a past chairman of the New England section of the National District Heating Assn.

HOWARD W DEXTER, 43, long active in the oil-burner industry, died of pneumonia Sept 30 at Greenwich, Conn. At the time of his death, Mr Dexter was general sales manager of Petroleum Heat & Power Co, Stamford, Conn.

JOHN W KING, one of the founders of Hedges-Walsh-Weidner Div of Combustion Engrg Co, died recently at Snyder, Tex. Mr King came to Chattanooga, Tenn., as a young man, and in partnership with Alfred Webb, started a boiler manufacturing organization. Upon Mr Webbs death, Mr King became sole owner. Later, he sold a half-interest in the company to the late M G Weidner, and for a time it operated under the name of King & Weidner Boiler Co. Later, Mr King sold his interest in the company to the late Patrick Walsh.

RICHARD K HENRY, 51, superintendent of buildings and grounds at Radcliffe College, Cambridge, Mass., lost his life Sept 23, being struck with a falling tree during rehabilitation work necessitated by the recent hurricane. Mr Henry was a graduate of the Hawley Engrg & Electrical School, Boston. During the world war he was an engineer in the merchant marine, and was later employed by the Pittsfield (Mass.) Electric Co.

BUSINESS ITEMS

RESEARCH PRODUCTS CORP, Madison, Wis., has recently purchased from C F Burgess Laboratories, Inc, the buildings and land at 1011-1015 E Washington Ave, Madison. The viscous-coated throwaway air filter, formerly known as the Burgess Air Filter, will be manufactured and marketed by Research Products Corp under the name of Walton Air Filter.

CHAIN BELT CO, Milwaukee, Wis, has elected Fred V Gardner acting treasurer to fill the vacancy created by recent death of C L Pfeifer. Mr Gardner, who has been connected with Chain Belt since the first of the year in a consulting capacity, was formerly associated with General Electric Co. G M Dyke, assistant treasurer was reelected, and A F Kessler, chief accountant, was named an assistant treasurer.

AHLBERG ROLLER BEARING CO, Chicago, Ill., will handle industrial distribution of bearings manufactured by Bower Roller Bearing Co, Detroit, Mich. While the Bower Co has been a leading manufacturer of roller bearings for the past 25 years, sales in the past have been almost entirely confined to the automotive industry.

CHICAGO BELTING CO, Chicago, Ill., has inaugurated a policy of branding all their double leather belts with what they claim is the first permanent brand-

Announcing the New...

TODD

*VARIABLE CAPACITY MECHANICAL PRESSURE ATOMIZING BURNER

A development in the burning of liquid fuel which provides:

1. UNLIMITED FIRING RANGE—

without change of burner tips
without change in oil delivery pressure
without change in angle of spray
without loss of atomizing efficiency

2. AUTOMATIC CONTROL—

without loss of efficiency over all firing ranges

STEAM requirements can be *instantly* and *automatically* followed, under all conditions, with maximum speed, economy and accuracy.

The Todd Variable Capacity Burner utilizes the basic principles of standard-type, mechanical pressure atomizing burners but is distinguished by its exclusive "varying range" feature. It saves fuel—reduces maintenance charges—increases plant efficiency. It has been subjected to the most rigid and exhaustive laboratory tests, and many installations are now in satisfactory use.

Although the new Todd Variable Capacity Burner is a combustion engineering triumph, it is but one of many Todd achievements. Todd service is world-famous and comprises the design and manufacture of the correct size and type of combustion equipment for every marine, commercial or industrial need. If you have a combustion problem—look to Todd for the answer!

*Patent applied for

TODD COMBUSTION EQUIPMENT, *Inc.*

Division of Todd Shipyards Corporation

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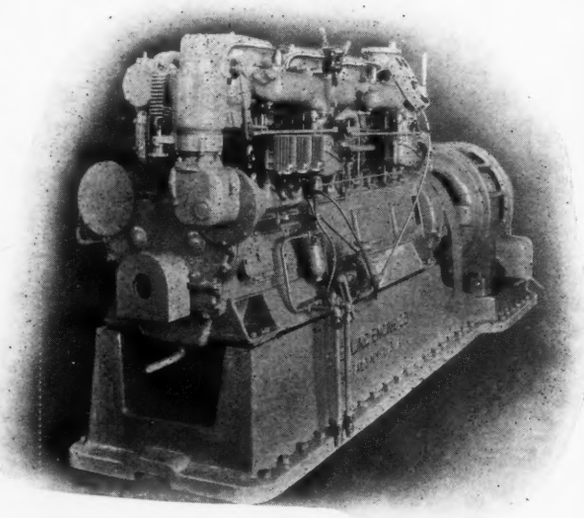
NEW YORK MOBILE NEW ORLEANS GALVESTON SEATTLE BUENOS AIRES LONDON

QUICK STARTING ENGINES

Capable of accepting immediate load
Extremely accurate governing
With Underwriters' Laboratory approval
Smooth under load, vibration eliminated
Are essential requirements for
Emergency sets for public building installations:

125 K. W. General Electric Generator direct connected to 1200 R.P.M. Sterling Dolphin 8-cylinder 240 H.P. engines, mounted on spring supported bedplate.



Sterling Engines qualify for most important emergency service.

SEE OUR EXHIBIT AT THE 13th NATIONAL EXPOSITION OF POWER AND MECHANICAL ENGINEERING, GRAND CENTRAL PALACE, NEW YORK, DECEMBER 5th to 10th.

STERLING ENGINE COMPANY

Home Office and Plant, 1270 Niagara Street, Buffalo, New York.

DEPT. C-1

Branch Office, 900 Chrysler Bldg., New York, N. Y.

ease in pump assembly

Quick precision adjustment of reciprocating pump bearings and gear shaft, for example . . . By simply peeling the paper-thin laminations from the solid brass Laminum shim. Right at the job . . . in assembly AND service adjustment! No filing, no machining. Write for Laminum sample (.002 or .003 in. laminations).

LAMINATED SHIM CO., INC. 21-60 44th Ave., Long Island City, N. Y.

933 Cleveland Detroit Milwaukee

LAMINUM
Precision adjustment SHIMS

ing ever devised for this type of belt. Their name is printed on the inside of the belt as the double belt goes through the tension cementing machine. The purpose is to enable user to re-order belts that give outstanding service.

PIONEER ENGRG & MFG CO, Detroit, Mich, has appointed Harris Pump & Supply Co, 320 Boulevard of the Allies, Pittsburgh, Pa., as representative for western Pennsylvania and northern West Virginia.

THE WEBSTER MFG CO, Tiffin, Ohio, which for the past year has been operating under receivership, was notified on Sept 24 that its reorganization plan had been approved by the Federal District Court at Toledo, Ohio. The new company will be known as Webster Mfg Inc, remaining under the present management, and will continue to manufacture elevating and conveying machinery and special heavy machinery.

AIR-MAZE CORP, Cleveland, Ohio, has moved to a new office and factory at 5200 Harvard Ave.

ROOTS-CONNERSVILLE BLOWER CORP, Connersville, Ind., has appointed two new territorial representatives: W J Brown, Charleston, W. Va., for most of that state and adjoining counties in Ohio and Kentucky; and H H Haight, Milwaukee, Wis.

RELIANCE GAGE COLUMN CO, Cleveland, Ohio, has appointed the following territorial representatives: Bell & Eiss, Inc, Foshay Tower, Minneapolis, Minn., for Minnesota, western Wisconsin, and North and South Dakota; and I C De Haven Engrg Co, 47 S Penn St, Indianapolis, Ind., for most of Indiana and Louisville, Ky.

TRICO FUSE MFG CO, Milwaukee, Wis., has appointed Marine Specialty & Mill Supply Co, 201 Julia St, New Orleans, La., as agent for Louisiana and southern Mississippi.

LEWIS SUPPLY CO, 477 S Main St, Memphis, Tenn., has recently taken over what formerly was the Southern Power Service, Inc, as a diesel-supply organization for the Mid-South handling Hill, Murphy and Buda diesels.

Meetings

American Society of Heating and Ventilating Engineers—*Annual Meeting, Jan 23–26, William Penn Hotel, Pittsburgh, Pa. A V Hutchinson, secretary, 51 Madison Ave, New York, N. Y.*

American Society of Mechanical Engineers—*Annual meeting, Dec 5–9, New York, N. Y. C E Davies, secretary, 29 W 39th St, New York, N. Y.*

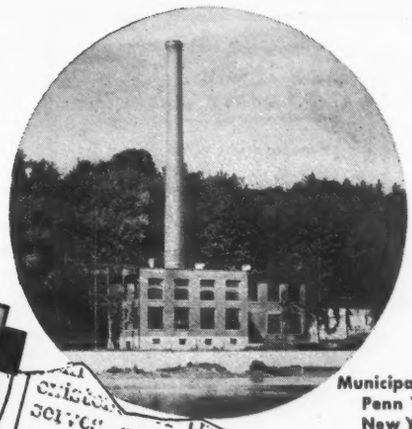
American Society of Refrigerating Engineers—*Annual meeting, Dec 6–8, Hotel Commodore, New York, N. Y. Headquarters office, 37 W 39th St, New York, N. Y.*

National Warm Air Heating and Air Conditioning Assn—*25th anniversary convention, Dec 12–14, Netherland-Plaza Hotel, Cincinnati, Ohio. Allen W Williams, managing director, 50 W Broad St, Columbus, Ohio.*

National Exposition of Power and Mechanical Engineering—*Dec 5–10, Grand Central Palace, New York, N. Y. Charles F Roth, manager, International Exposition Co, New York, N. Y.*

PENN YAN Pays Dividends

DETROIT STOKERS



Municipal Plant
Penn Yan,
New York

Municipal Plant Paying Dividend in Free Lights

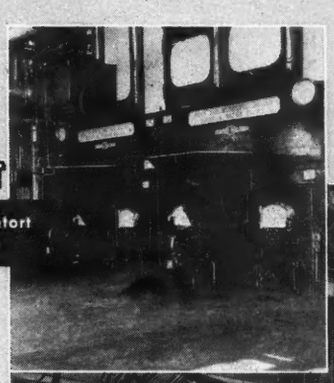
PENN YAN, N. Y., July 30 — (A. P.) — Penn Yan consumers of electricity found their July bills paid in full today, a dividend of a month's free current from the municipally owned and operated plant.

H. Allen Wagener, president of the Municipal Board which manages the plant, said the bills would total about $5,500, divided among 2,232 consumers.

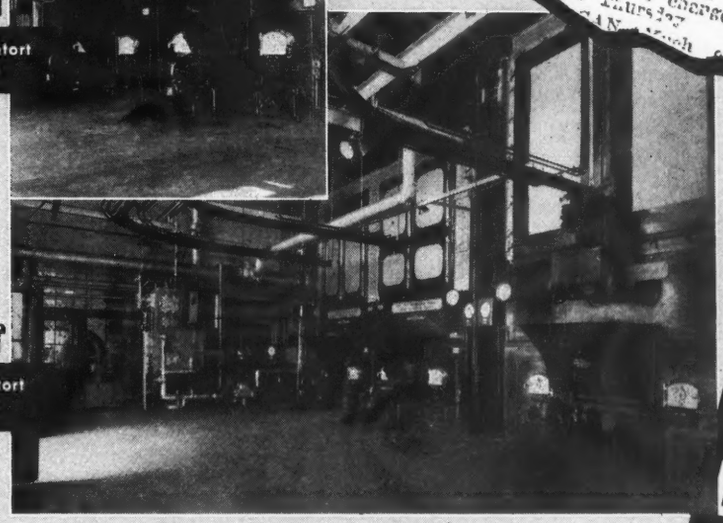
This gift brings to a total of $52,000 the dividends in free current that the board has passed on to users during an eight-year period.

1ST CONTRACT
Detroit Single Retort Stoker—1927

2ND CONTRACT
Detroit Double Retort Stoker—1929



3RD CONTRACT
Detroit Triple Retort Stoker—1932



Detroit Stokers in Municipal Plant, Penn Yan, New York

For LOW STEAM COST DETROIT STOKERS

Write for Bulletin 530

DETROIT STOKER COMPANY

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Main Office and Works • Monroe, Michigan • Built in Canada at London, Ont.
District Offices in Principal Cities

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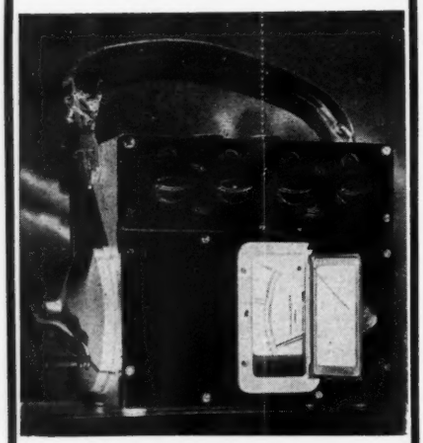
"Many Times Over"



"Bridge-Meg" Resistance Tester. A combined "Megger" Tester and Wheatstone Bridge—the Electrician's complete resistance measuring outfit.

In the Plant Engineer's own words:

"We bought our 'Megger' primarily to aid us in salvaging electrical equipment after the 1937 flood, and it enabled us to save nearly 100 pieces of apparatus with but one or two final failures, and thus we feel it has paid for itself many times over.

The 'Megger' instrument is now used for checking periodically all of our electrical equipment and is contributing to lower maintenance costs."

—Louisville, Ky.

You do not need to wait for a flood. Begin *now* to save money by using a "Megger" instrument.

Write for Bulletin 1580-P entitled "MEGGER" INSURANCE.

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Other Biddle Specialties:

"Megger" Ground Testing Instruments
"Megger" Capacitance Meter
"Megger" Direct-Reading Ohmmeters
"Ducter" Low Resistance Testing Sets
"Dionic" Water Tester
"Frahm" Vibrating-Reed Tachometers and Frequency Meters
"Jagabi" Rheostats
"Jagabi" Speed-Measuring Instruments

STRAWS

Pointing the way business winds blow

ALABAMA——Board of Jefferson County Commissioners, Birmingham, plans central-heating plant in new 14-story county hospital. Cost about $2,000,000. Financing has been arranged. H McCauley, Jackson Bldg, architect.

ARKANSAS——Caddo River Lumber Co, Forrester, plans rebuilding of power house and other sections of lumber and planing mill recently destroyed by fire. Loss over $200,000, with equipment.

CALIFORNIA —— Metropolitan Water District, Los Angeles, plans large water-softening and filtration plant in connection with Colorado River aqueduct water supply system. Estimates of cost are being made. F E Weymouth, chief engineer and general manager.

May Co, 801 S Broadway, Los Angeles, plans central-heating plant in 5-story and basement department store. Air-conditioning system also will be installed. Cost over $500,000. A C Martin, Higgins Bldg, architect.

Tulsa-Santa Monica Corp, Santa Monica, care of W E Foster, Bank of America Bldg, Beverly Hills, architect, plans central-heating plant in 7-story apartment building, for which bids will be asked soon. Cost about $250,000.

Board of County Supervisors, Courthouse, Los Angeles, plans motor-driven pumping plant at new county prison farm, Dunn Ranch, near Castaic. $100,000 has been arranged for project. R E Shonerd, county engineer.

Board of Education, Alhambra, plans central-heating plant at new Mark Keppel high school group. Cost about $750,000. Financing through Federal aid. Marston & Maybury, 25 S Euclid Ave, Pasadena, architects.

COLORADO——Meeker plans extensions in municipal hydro-electric plant. Cost about $27,000. Financing arranged through Federal aid.

Mesa County Junior College District, Grand Junction, J A Edling, secretary, plans central-heating plant in new 2-story and basement junior college building. Cost about $300,000. Financing arranged through Federal aid. Atchison & Emery, 1254 Monaco St, Denver, architects.

CONNECTICUT——Dept of Water and Light, Groton, plans municipal filtration plant for water system. $163,500 has been arranged through Federal aid. Metcalf & Eddy, Statler Bldg, Boston, Mass., consulting engineers.

FLORIDA——Acadia has arranged $210,000 through bond issue of $110,000, recently voted, and Federal financing for $100,000, for new municipal electric plant. J E Craig, Miami, consulting engineer.

GEORGIA——South Georgia Pecan Co, Valdosta, plans rebuilding of cold-storage plant at local pecan factory, recently destroyed by fire. Loss about $75,000, including portion of main factory.

McElrath Mfg Co, Milledgeville, plans boiler house at mill to replace plant recently destroyed by fire. Cost over $25,000, with boiler units and auxiliary equipment.

Capitol Square Improvement Commission, Atlanta, Dr M D Collins, chairman, plans central-heating plant in new multi-story state office building in Capitol Square. Cost about $815,000. Work will begin before close of year.

IDAHO——Cassia County Board of Commissioners, Burley, plans central-heating in new 2-story court house on local site. Cost about $115,000. Financing arranged through Federal aid. Bids will be asked soon. Burton E Morse, Twin Falls, architect.

ILLINOIS——Marine Drive Apartments, Inc, Chicago, care of Oman & Lilienthal, Inc, 435 N Michigan Ave, architects, plans central-heating plant in 8-story apartment building. Will include two boiler units, with stokers and accessories. Cost about $1,500,000.

INDIANA——Gary Screw & Bolt Co, 2225 W 43rd St, Gary, contracted W B Graves Heating Co, 162 N Desplaines St, Chicago, Ill., for boiler unit and auxiliary equipment for power house at warehouse and office building.

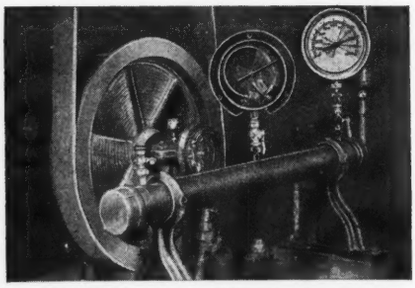
Jasper plans improvements in municipal power plant, including boiler unit and auxiliary equipment. Cost about $71,400. John M Rotz Engrg Co, Merchants' Bank Bldg, Indianapolis, consulting engineer.

Albion will award contracts soon for extensions in municipal power plant, including 500-kw turbine-generator, 900-sq. ft surface condenser, two watertube boilers, stokers, pumps and accessories. C C

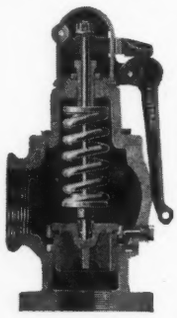
PERFORMANCE *Plus*

- that's **LONERGAN**

All LONERGAN Valve Seats are passed through the Lonergan Lapping Process to insure tightness.

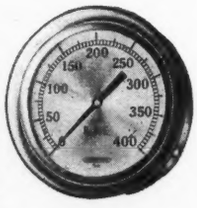


The LONERGAN Whip Test has been conducted on the same Lonergan Gauge, 82 pulsations a minute, 8 hours a day, since July 22, 1936. This gauge is still in perfect condition—undeniable proof of the stamina and inbuilt supremacy of LONERGAN Gauges.



MODEL WT (Left) POP SAFETY VALVE

A. S. M. E., Iron Body, Bronze Mounted. Designed for Water Tube and all types of boilers. Relieving capacity based on sustained lift of disc. Positive in action—opens and closes sharply.



MODEL BOE (Right) PRESSURE GAUGE

Standard single seamless drawn Bourdon tube gauge of "Super-Service" type. Graduated to any pressure from 15 to 1000 lbs. Standard sizes up to 12". Connection, all sizes, ¼" pipe thread.

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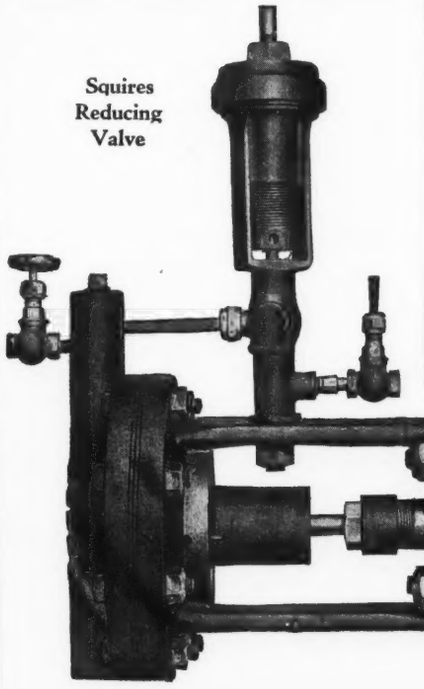
Genuine Squires Steam Trap

Squires Boiler Feed Water Regulator



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Squires Pump Governor Class "H"

More than 30 years In the power field

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THE C. E. SQUIRES COMPANY

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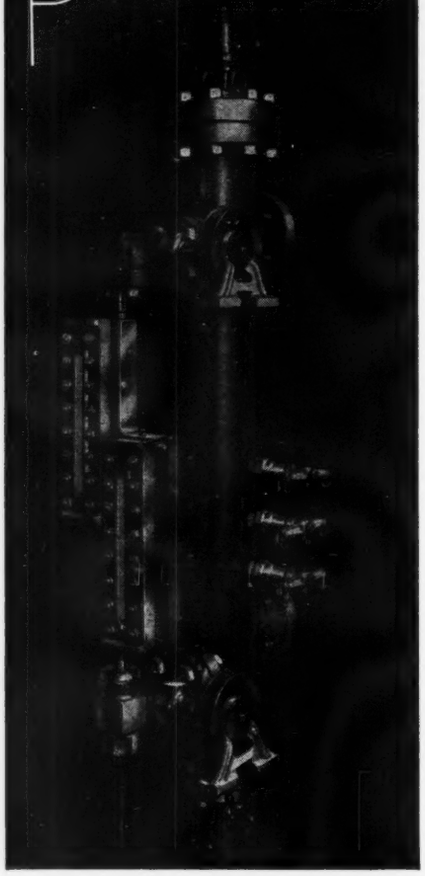


Yarway's unique Hi-Lo Alarm mechanism utilizes balanced *solid weights* that are as indestructible and unchanging as the metal itself. Operating on the displacement principle, they literally "weigh the water level."

When the high or low water emergency occurs—instant, positive, powerful, hair-trigger *action* results—giving warning of danger by whistle, light, or both.

Yarway Water Columns, eight standard models, iron bodies with screwed connections for pressures up to 250 lbs., forged steel bodies with flanged connections for pressures up to 1500 lbs., are fully described in Catalog WG-1806. Write for a copy and working model.

YARNALL-WARING COMPANY
100 Mermaid Ave. Philadelphia

YARWAY
FLOATLESS HI-LO ALARM
WATER COLUMN

Wilcox, 1507 Colfax St, South Bend, consulting engineer.

IOWA——Board of Trustees, Iowa State College, Ames, has low bid at $53,357 from Groeschel Co, Marshall, Mo., for addition to steam power house at institution. Entire project will cost close to $200,000.

Remsen contracted Worthington Pump & Machinery Corp for 450-hp diesel-generator unit, cooling-water and oil-purifying systems and auxiliary equipment, at $42,000, for municipal power plant.

KANSAS——Burlington contracted Fairbanks, Morse & Co, Chicago, Ill., for generator unit and auxiliary equipment for municipal power plant, at $24,000. Improvements will be carried out at station. Paulette & Wilson, 1006 Kansas Ave, Topeka, consulting engineers.

Waterville will award contracts soon for engine-generator unit and auxiliary equipment for municipal power plant. Cost over $60,000. Paulette & Wilson, 1006 Kansas Ave, Topeka, consulting engineers.

Ottawa contracted A L Cook, Ottawa, for alterations and improvements in municipal power-plant building, at $19,436, exclusive of equipment, for which awards will be made separately. Black & Veatch, 4706 Broadway, Kansas City, Mo., consulting engineers.

Winfield will award contracts soon for equipment for expansion in municipal power plant, where new addition, 60 x 70 ft, will be built. Cost about $177,000, of which over $125,000 will be used for equipment installation. Financing through Federal aid. Black & Veatch, 4706 Broadway, Kansas City, Mo., consulting engineers.

St. John contracted A F Roberts, Sabetha, for new municipal power plant. Cost about $75,355, with diesel-generator units and auxiliary equipment. A W Hefling, East Second St, Hutchinson, consulting engineer.

KENTUCKY——Campbell County Board of Education, Courthouse, Alexandria, plans central-heating plant in new 2-story high school. Cost about $125,000. E C Landberg, 114 Garfield Pl, Cincinnati, Ohio, architect.

LOUISIANA——Delcambre plans pipelines for municipal natural-gas distribution system, including control station and operating facilities. Bond issue of $25,000 is being arranged and further financing will be carried out through Federal aid.

Eunice plans pipeline system for municipal natural-gas distribution. Bond issue of $115,000 has been approved. Project will include a control station and welded-steel pipeline for connection with supply source. J B Lewis, mayor, in charge.

Melville plans expansion in municipal power plant and waterworks station, including additional equipment. Bond issue of $25,000 has been approved. Work schedule to begin soon.

Natchitoches Parish Police Jury, Courthouse, Natchitoches, plans central-heating plant in new parish courthouse and jail building on local site. Cost about $258,000 J W Smith & Associates, Monroe, architects.

St. Landry Parish Police Jury, Opelousas, plans central-heating plant in new parish courthouse and jail building on local site. Cost about $500,000, of which $275,000 will represent a bond issue, recently voted, and remainder a Federal grant. L Perrier, 339 Carondelet St, New Orleans, architect.

Thibodaux will place contract soon for new generator unit and auxiliary equipment for municipal power plant. $80,000 has been arranged for expansion.

MARYLAND——State Board of Welfare, Union Trust Bldg, Baltimore, plans central-heating plant in new penal institutional building at Jessups. Cost about $445,000. Financing through Federal aid. Henry G Perring, 10 W Chase St, Baltimore, architect.

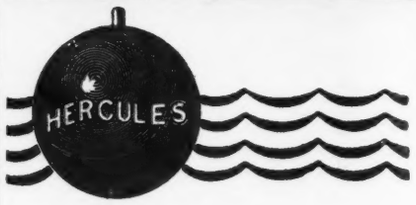
City Council, Hagerstown, plans central-heating plant in multi-story city hall building. Cost about $410,000. Taylor & Fisher, 1012 N Calvert St, Baltimore, architects.

MASSACHUSETTS——Reed & Prentice Corp, 677 Cambridge St, Worcester, contracted Fiske-Carter Construction Co, 8 Norwich St, for improvements in boiler house at machine tool works.

Consolidated School District, Becket, Leonard B Wilson, chairman, plans central-heating plant in new school building. Cost over $125,000. Financing through Federal aid. Ralph M Sizer, 12 Elm St, Westfield, architect.

MICHIGAN——Clinton plans extensions

HERCULES
Seamless Copper
FLOATS



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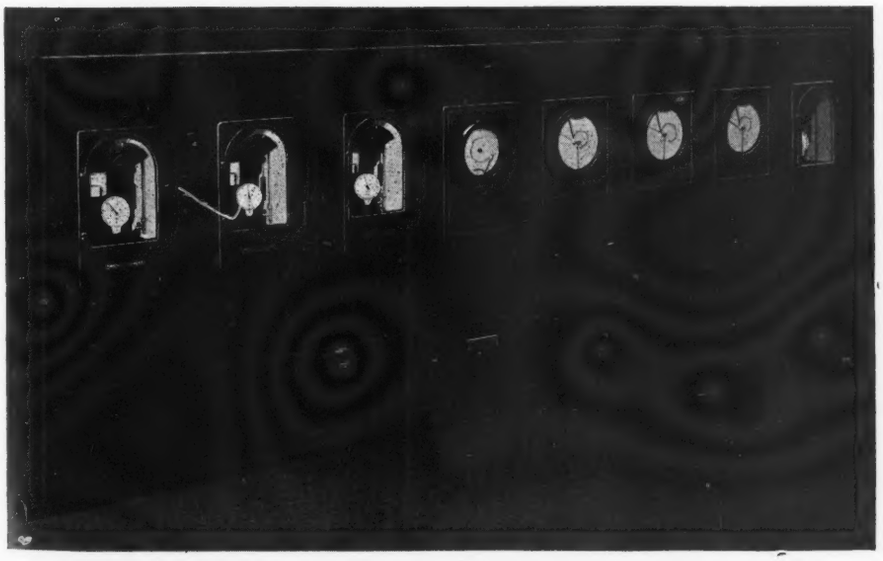

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A compact, flexible instrument, actuated by the Simplex Bell-Shaped float. Available as an Indicator, a Recorder, a Totalizer, or with any combination of these scales. Measures any type of fluid.

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A mechanically-operated meter register whose unequalled range of flow measurement and extreme sensitivity have resulted in its selection in industry for fluids of every description.

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CLYDE BLOW-OFF SET

	Units
Blow-off valves, full Stainless steel trim	2
Flanged Union — Stainless steel Joint Ring	1
3 UNITS in 1	**3**

That's why it costs less to buy, and less to apply.

- . . . Straight line flow
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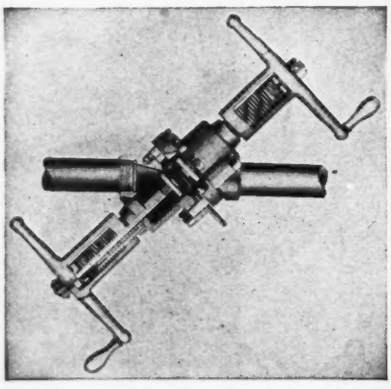

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fully describing this remarkable valve—also the CLYDE line of High Pressure Strainer Valves—Boiler Feed Stop and Checks—Non-return Stops—Globe Valves—Check Valves—CLYDE '45' Valves.

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Power & Mechanical Engineering Exposition

CLYDE DIVISION
R. W. CRAMER & COMPANY, Inc.
67 Irving Place New York City

in municipal electric plant. Work scheduled to begin soon. Cost about $80,000.

Hillcrest Corp, Lansing, care of Raymond C Snow, 1223 Connecticut Ave, NW, Washington, D. C., architect, plans central-heating plant in new multi-story apartment building at East Lansing. Cost about $1,800,000. Work scheduled to begin soon.

Flint Housing Authority, Flint, plans central-heating plant in connection with housing project, consisting of group of 2-story buildings. Cost about $800,000. Financing has been arranged through Federal aid.

State Dept of Buildings, Capitol Bldg, Lansing, contracted James W Partlan, 14290 Godard Rd, Detroit, for mechanical equipment for new power house for state institutional buildings at Wahjamega, at $230,644.

MINNESOTA——Sherburn has approved bonds for $112,000 for new municipal electric plant, including engine-generator unit, boilers and auxiliary equipment. Proposed to begin work soon. Ralph D Thomas & Associates, 1200 2nd Ave, South, Minneapolis, consulting engineers.

Staples plans call for bids early this month for new water-softening plant for municipal water system. Estimates of cost are being made. P C Bettenburg, Inc, 1437 Marshall Ave, St. Paul, consulting engineer.

St Agnes R C Parish, 500 Lafond St, St Paul, plans central-heating plant in 3-story and basement parochial school. Cost about $250,000. E J Prondzinski, Pence Bldg, Minneapolis, architect.

Melrose plans improvements in municipal power plant, including diesel-generator unit with accessories to replace old engine-generator equipment. Cost about $53,000. Financing through Federal aid. Ellerbe & Co, First National Bank, St Paul, consulting engineers.

MISSISSIPPI——Ripley plans municipal cold-storage and refrigerating plant, and has arranged $29,500 for project through bond issue and Federal aid. Work will begin soon.

Quitman has voted bonds for $20,000 and will arrange additional financing for 1-story municipal cold-storage and meat-curing plant. Work is scheduled to begin soon.

E S Palmer, Forest, plans rebuilding of portion of ice-manufacturing and refrigerating plant, recently destroyed by fire. Loss about $30,000, with equipment.

Kosciusko plans improvements in municipal power plant and waterworks station. Cost about $65,000. Bond issue has been approved and work is scheduled to begin soon.

Centerville has low bid from Texas Automatic Sprinkler Co, Dallas, Tex., at $53,400 for pipeline system for municipal natural-gas distribution and will make award soon. Huey & Cage, Monroe, La., consulting engineers.

City Council, Vicksburg, and Board of Warren County Commissioners, Vicksburg, plan central-heating plant in new multi-story courthouse. Cost about $600,000. Havis & Havis, Vicksburg, architects.

MISSOURI——Eldorado Springs has completed plans for municipal electric plant, using diesel-generator units and auxiliary equipment. Cost about $120,000. W B Rollins & Co, Railway Exchange Bldg, Kansas City, consulting engineers.

Lockwood plans municipal electric plant. Proposed to use diesel-generator units and accessories. $54,500 being arranged.

Lathrop plans municipal electric plant and distribution system. Cost about $75,000. E T Archer & Co, New England Bldg, Kansas City, consulting engineers.

Weston plans municipal power plant, using diesel-generator unit and auxiliary equipment. Cost about $85,000. E T Archer & Co, New England Bldg, Kansas City, consulting engineers.

Lees Summit plans municipal electric plant. Proposed to use diesel-generator units and auxiliary equipment. Cost about $150,000. E T Archer & Co, New England Bldg, Kansas City, consulting engineers.

Monett plans extensions in municipal power plant and waterworks station, including additional equipment. Cost about $25,000. Work scheduled to begin soon.

Odessa will soon place contracts for equipment for municipal electric plant and distribution system. $139,000 has been arranged. E T Archer & Co, New England Bldg, Kansas City, consulting engineers.

Palmyra plans municipal power plant, using diesel-generator units and auxiliary equipment. Cost about $66,800. Frank Beard, Kahoka, consulting engineer.

MONTANA——Board of Directors, Montana State University, Missoula, plans steam power house on campus for central-

FYR-FEEDER

BURNS CHEAPEST COALS CUTS COAL COST

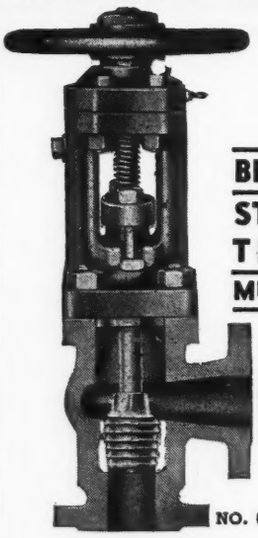
Fyr-Feeder is slashing coal costs for power plant operators because it successfully burns the cheapest screenings — minus ⅛"—minus ¼"—bug-dust—or any screenings up to 1½"—wet or dry.

Fyr-Feeder has further money saving advantages—lower operating costs—flexible operation — steady steam pressure — increased boiler capacity. Reduces banking losses — Eliminates expensive maintenance.

Data sheet No. 41 shows how four Fyr-Feeder equipped plants have made savings averaging 31.7% even though all four plants previously had stoker equipment. Write for your copy of this interesting sheet and bulletin 77 which describes the Fyr-Feeder in detail.

AMERICAN COAL BURNER CO.
FOUNDED 1918
167 EAST SUPERIOR STREET, CHICAGO.

MULTI-VALVES



BLOW - OFF
STOP AND THROTTLE
MULTI - STAGE

Universal Service

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TROY . . . NEW YORK

Big Savings
made by Vane Controlled Draft Fans

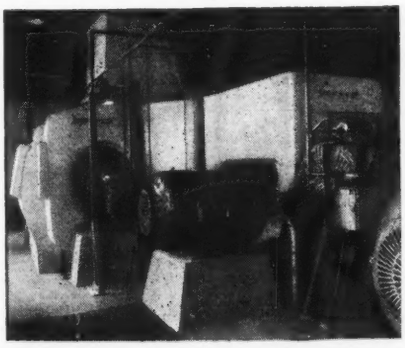
TYPICAL EXAMPLE AT RCA-VICTOR

R.C.A. Victor selected two Forced Draft and two Induced Draft Sturtevant Patented Vane Controlled Fans for their new 120,000 lb. steam per hour boilers. They were convinced of their many advantages resulting in worthwhile savings.

Sturtevant Vane Control Advantages

1. Assures quick, accurate regulation of pressure and volume.
2. High efficiency.
3. Reduces motor power consumption.
4. Permits use of constant speed motors, instead of more costly variable speed motors.
5. Eliminates the expensive and complicated control required for variable speed motors.

Because of the *proved* advantages of Sturtevant Vane Control Draft Fans, they have been selected for many recent plants including:



Sturtevant Vane Controlled Induced Draft Fans installed at RCA-Victor Manufacturing Company, Camden, N. J.

One of two Sturtevant Vane Controlled Forced Draft Fans installed in plant of RCA-Victor Manufacturing Company, Camden, N. J.

Standard Oil Co. of Southern California
Consolidated Edison Co. of N.Y.
Virginia Electric and Power Co.
Tampa Electric Co.
Spreckels Sugar Co.
Richfield Oil Co.
Pacific Gas and Electric Co.
Louisiana Steam Products Co.

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Sturtevant
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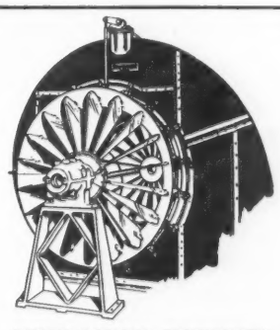
Puts Air to Work



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1. Pressure and volume regulated by movable vanes, located in the Fan inlets, as illustrated above. Vanes operated either manually or by automatic combustion control.
2. Result: quick, accurate response to varying load requirements.
3. Combines the flexibility and immediate response of dampers with efficiency of variable speed control.

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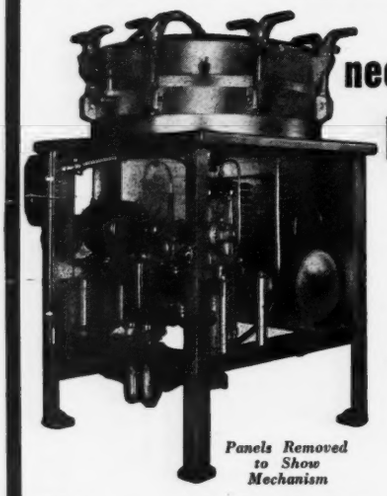
MODERN DIESELS and TURBINES need the Hilco OIL RECLAIMER



Panels Removed to Show Mechanism

The Hilco is a continuous, all-electric automatic purifier which delivers an oil completely free of carbon, sludge, moisture, fuel dilution, acids and tarry matter. Actually it restores oil to its original specifications at a saving of 50 to 75% in lube costs. Can be direct connected to one or more engines or turbines for continuous or intermittent use or as a batch reclaimer if you prefer to drain.

There is a model of sufficient capacity for every size power plant.

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Engineered to lick your Packing problem

If your packing problem is tough or difficult, Lion Hydraulic packing will solve your difficulty.

An exclusive feature of "Lion" is the molded lip which automatically insures tightness in proportion to the pressure. It wears longer, always responds to working pressure, definitely prevents leakage and will stand the highest pressures. Anti-Friction metal studs form a continuous metal bearing face and reduces friction.

The Ideal packing for Rams or Plungers of Heavy Duty Presses, Accumulators, Pumps and all hydraulics. Will cut your packing costs.

"LION" packing is also available for Highest steam pressures, Air Gas, etc.

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heating service. Cost about $75,000. R C Hugenin and Norman DeKay, 440 N Benton St, Helena, architects; T G Swearingen, at University, mechanical engineer.

NEBRASKA——Cozad awarded a contract to Fairbanks, Morse & Co for construction of and equipment for a municipal power plant, estimated to cost about $200,000. Robert Fulton, 2327 S 19th St, Lincoln, is consulting engineer.

Auburn plans municipal power plant and distributing system. $342,000 being arranged through bond issue.

NEW MEXICO——Middle Rio Grande Conservancy District, Albuquerque, plans hydroelectric plant on Upper Rio Grande River, with power dam, generating station, transmission lines, etc. Cost about $3,500,000. W C Ostreich, engineer.

Tucumcari plans municipal electric plant, using diesel-generators and auxiliary equipment. Cost about $416,363. Proposed to begin work soon. Powell & Goldenberg, 127 E Water St, Santa Fe, consulting engineers.

NEW YORK——Board of Education, City Hall, Buffalo, plans central-heating plant in 3-story high school Cost about $1,400,000. Bids will be asked soon. Architectural Dept, address noted, is preparing plans.

NORTH CAROLINA——High Point has revised plans under way for municipal hydroelectric plant on Yadkin River, near Winston-Salem, for which additional financing in amount of $6,492,600 has been arranged through Federal loan and grant. Bids are scheduled to be asked soon. Murray & Flood, Inc, 369 Lexington Ave, New York, N. Y., consulting engineers.

NORTH DAKOTA——Valley City has low bid from A R Robertson Co, 1603 University Ave, St Paul, Minn., for extensions in municipal electric plant, including installation of boiler units and other equipment, and will place award soon. Cost about $161,750. Burlingame, Hitchcock & Estabrook, Inc, Sexton Bldg, Minneapolis, Minn., consulting engineer.

Board of Williams County Commissioners, Williston, plans central-heating plant in new 3-story courthouse. Cost about $140,000. Ira L Rush, 616 Lincoln Dr, Minot, architect.

OHIO——Board of Trustees, Kent University, Kent, plans steam power house at institution, for central-heating service. Bids will be asked soon. Cost about $135,000. J P Schooley, State Office Bldg, Columbus, state architect, in charge.

Monroeville will take bids early this month for municipal power plant, including three diesel-generator units and auxiliary equipment. $78,180 has been arranged. William C Kammerer & Associates, Euclid Bldg, Cleveland, consulting engineers.

Bluffton contracted J A Young Co, Toledo, for boiler unit and auxiliary equipment for municipal power plant; also, Detroit Stoker Co, Detroit, Mich., for stoker and controls; and for coal-handling equipment, Fairfield Engrg Co, Marion. $42,600 has been arranged for entire project. Carl J Simon & Associates, Evans-Central Bldg, Van Wert, consulting engineers.

New Washington plans municipal electric plant. Cost about $123,000. Carl J Simon & Associates, Evans-Central Bldg, Van Wert, consulting engineers.

Pennsylvania Railroad Co plans new coaling station in Sandusky Bay, Sandusky, with large capacity for loading. Cost over $350,000. Engineering Dept, 516 W Jackson Blvd, Chicago, Ill.

Port Clinton plans municipal electric plant. Cost about $300,000. Work scheduled to begin soon.

Martins Ferry plans improvements in municipal electric plant, including 3000-kw turbine-generator and auxiliary equipment. Cost close to $395,000. Burns & McDonnell Engrg Co, 107 W Linwood Blvd, Kansas City, Mo., consulting engineer.

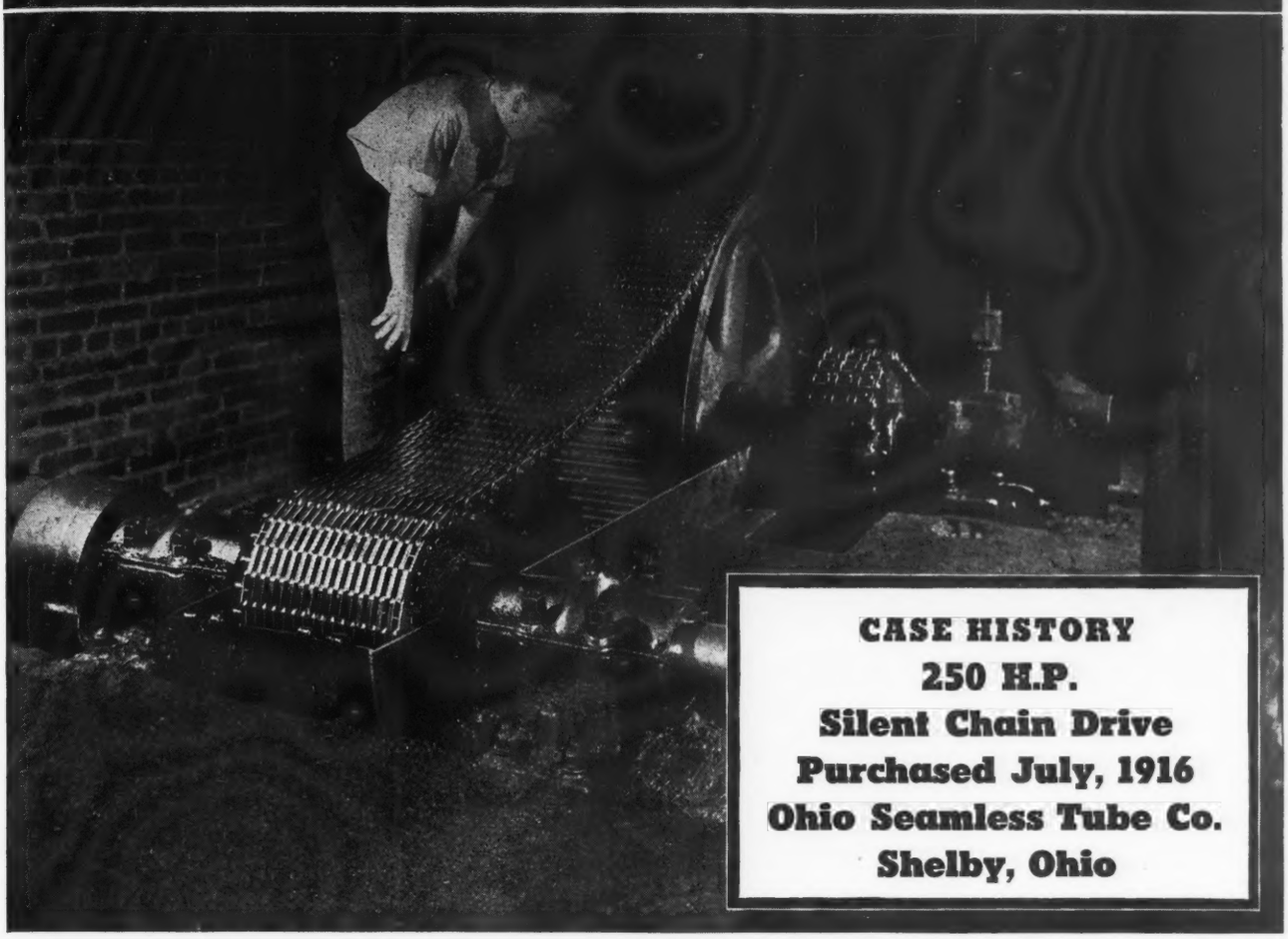
Amherst has completed financing for $145,000 through Federal aid for new municipal electric plant, and will begin work soon. Floyd Browne, Marion, is consulting engineer.

OKLAHOMA——Drumright will begin work soon on municipal electric plant and distribution system. $280,000 has been arranged. W Leonard Austin, Cushing, consulting engineer.

Claremore plans improvements in municipal power plant, including 500-hp gas engine-generator unit and auxiliary equipment. Cost about $71,000.

Board of Trustees, Oklahoma Agricultural and Mechanical College, Stillwater, plans power house at institution. Cost about $675,000. P A Wilber, Mechanical College, engineer.

SILENT CHAIN PERFORMANCE FACTS



REPAIR PARTS COST . . . ONLY $3.19 PER YEAR
—here's proof of amazing cash savings!

● When it comes to long life and low maintenance expense there is no other type of drive that can even approach the efficiency of the Link-Belt Silverstreak silent chain drive. It requires practically no attention and little upkeep. Definite proof of this is illustrated above—the chain drive shown has been operating steadily for 22 years and has required in all that time a total repair cost of only $70.00, which figures a mere $3.19 per year. Think of this the next time you buy a "drive." Get your money's worth—specify Link-Belt Silverstreak Silent Chain Drives! Send for Data Book No. 125, also for books on any or all of the Link-Belt positive drives illustrated below. Link-Belt Company, Indianapolis, Chicago, Philadelphia, Atlanta, San Francisco, Toronto. Branch offices and distributors located in all principal cities.

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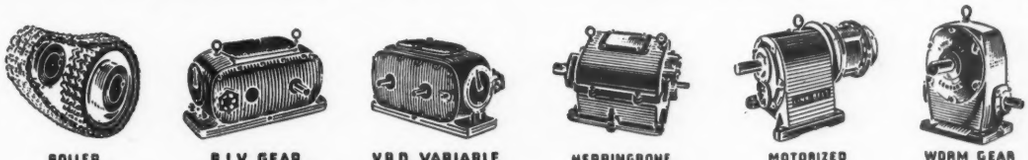
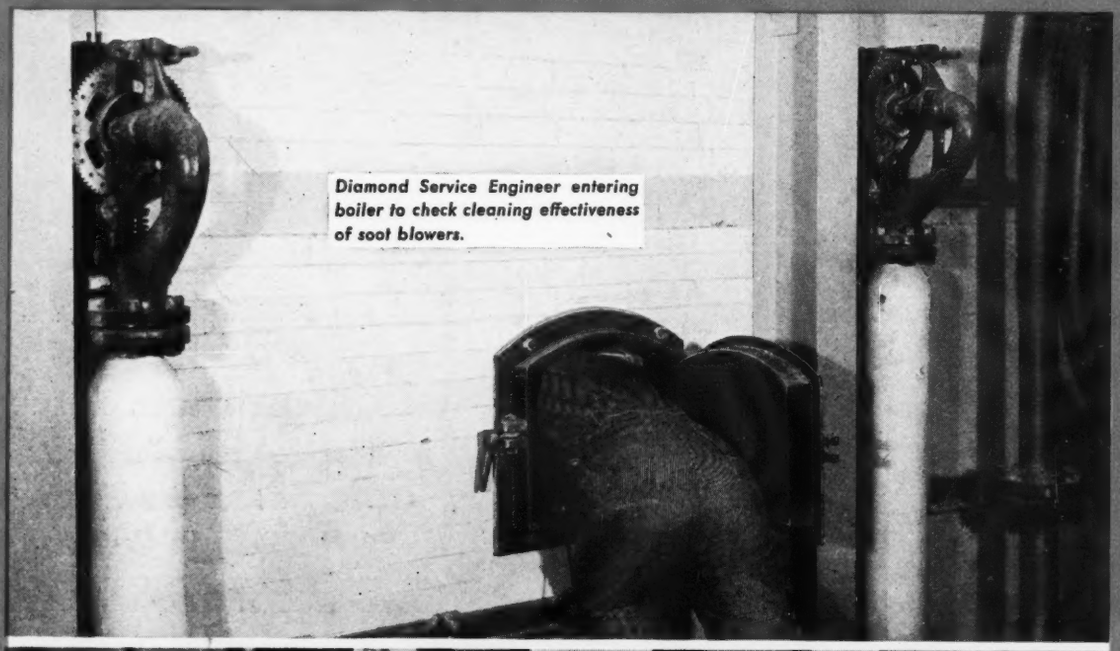


LINK-BELT

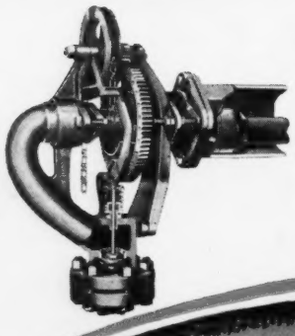
SILVERSTREAK SILENT CHAIN DRIVES

DIAMOND sells you



Diamond Service Engineer entering boiler to check cleaning effectiveness of soot blowers.

Diamond Service Engineer showing operator how his flue gas temperature drops when soot blowers are used correctly and regularly.



*

"Automatic Valved"— distinguished from all other types in that a single operation opens and closes the valve in head and simultaneously rotates the element.

CLEAN BOILERS
AT LOWEST COST

Not merely
SOOT BLOWERS

You receive much more than just soot blowers when you buy from Diamond.

You receive also the assurance that your boilers will be kept clean year after year . . . with the least amount of effort and expense.

The unique Diamond Service Policy provides this assurance. Under this policy, every installation of Diamond Soot Blowers for water tube boilers is regularly inspected and adjusted by Diamond Service Engineers—unsolicited and without charge. Such service has been rendered continuously since 1919. At present, 15 Diamond Service Engineers work from strategic points throughout the country.

This service makes certain that the boilers are cleaned correctly . . . that the Diamond Soot Blowers are in good repair and adjustment . . . that the operators are thoroughly familiar with their use and care. The user is also invited to call upon the Diamond Service Engineer in his vicinity for advice and help in solving any boiler-cleaning problem. In many instances these inspections, adjustments and suggestions have prevented serious trouble and expense.

There is nothing else like this Diamond Service Policy in the power plant equipment field. It is one of several reasons why more than 81% of the soot blowers in modern power plants are Diamond.

It is one of many reasons why you should have Diamond "Automatic *Valved" Soot Blowers in your boilers.

Diamond Service Engineer instructing operator in the correct use of his Diamond "Automatic Valved" Soot Blowers.

DIAMOND
POWER SPECIALTY CORPORATION
DETROIT, MICHIGAN
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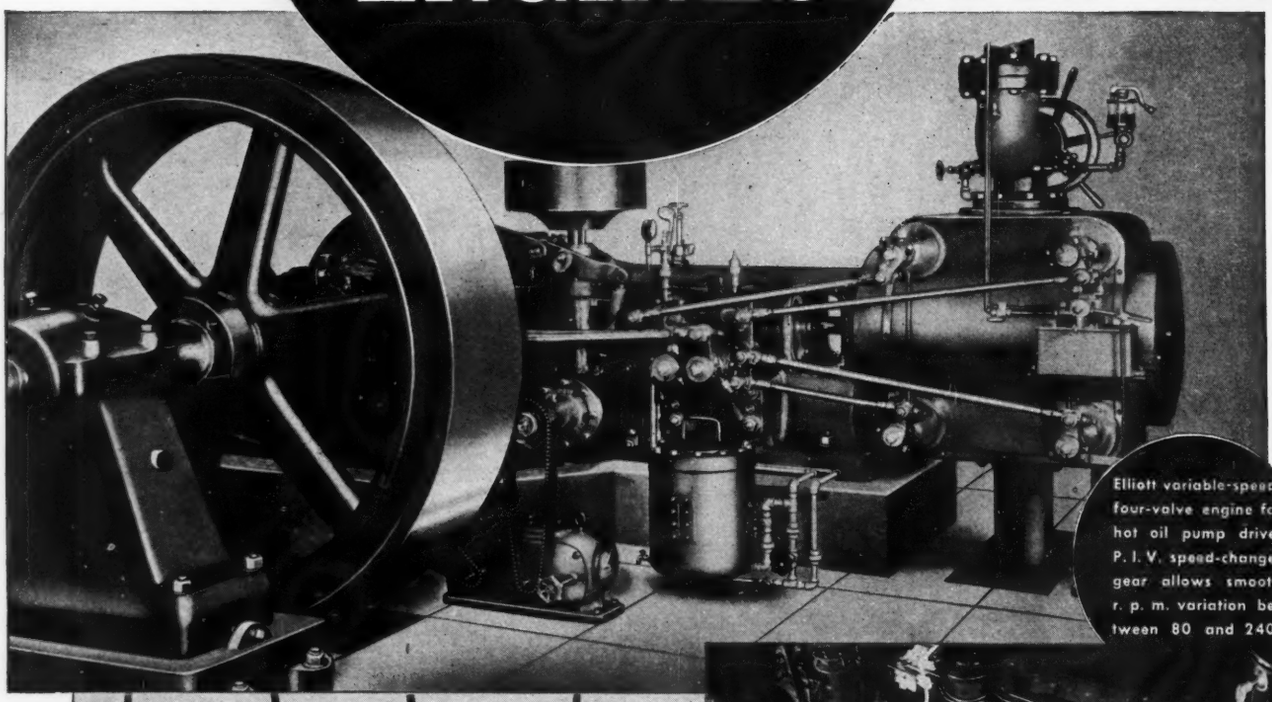
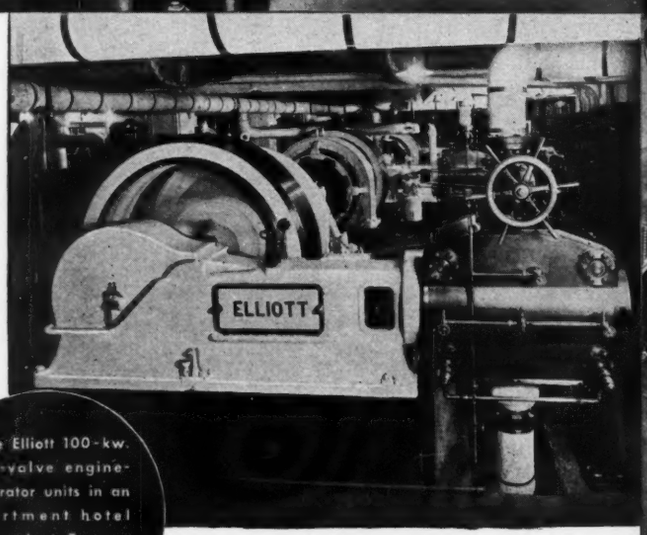
ELLIOTT STEAM ENGINES... FIT THE P



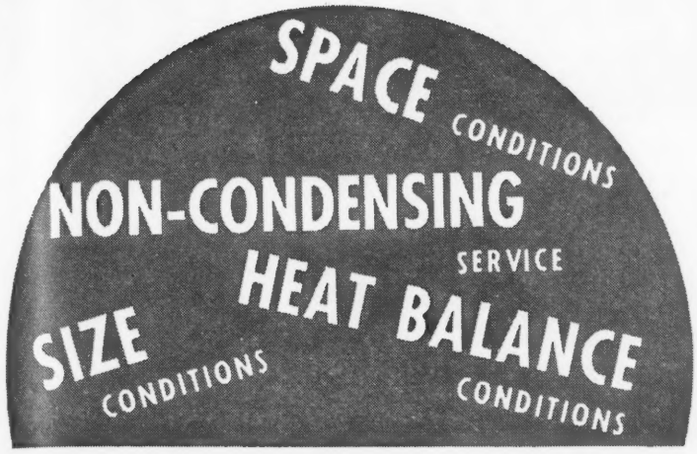
Elliott variable-speed, four-valve engine for hot oil pump drive. P. I. V. speed-changer gear allows smooth r. p. m. variation between 80 and 240.



Three Elliott 100-kw. four-valve engine-generator units in an apartment hotel power plant. Two are Corliss unaflow, one a single-valve.

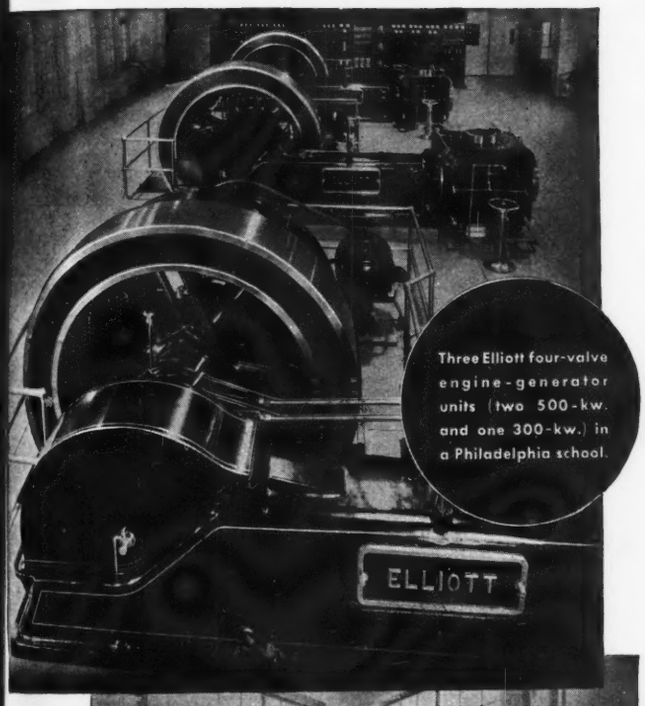
Elliott four-valve counterflow engine driving an ammonia compressor.

B-317

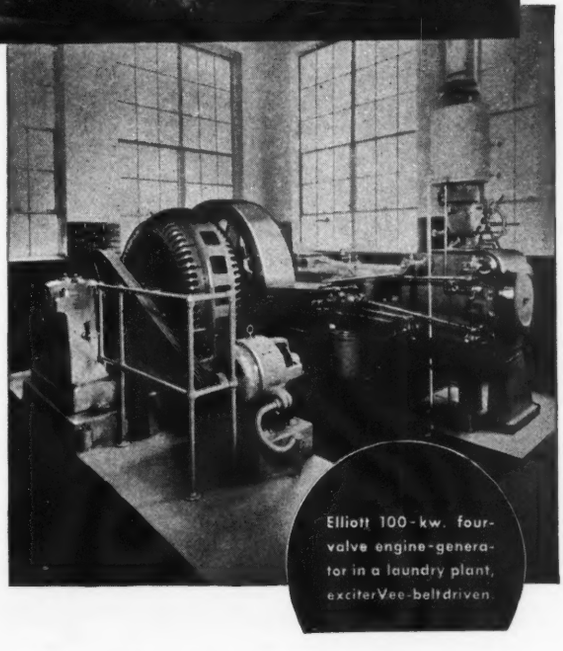


The development of other types of prime movers has helped to define clearly the field of the reciprocating steam engine—a field in which it is eminently fitted to serve. Modern engines such as these that Elliott is building, fill certain requirements which cannot be as ably met by any other type of unit.

PICTURE IN MANY PLANTS



Three Elliott four-valve engine-generator units (two 500-kw. and one 300-kw.) in a Philadelphia school.



Elliott 100-kw. four-valve engine-generator in a laundry plant, exciter Vee-belt driven.

Steam engines — the old reliables among prime movers — have a definite place in the power picture, particularly in non-condensing service, certain heat balance conditions, and other factors present in individual installations. These factors are covered by the four types in which Elliott steam engines are built — single-valve and four-valve counterflow engines, poppet-valve and Corliss-valve unaflow engines.

If you need a steam engine, one of these types will meet the conditions. The recommendation of the Elliott sales engineer may be accepted on this point with confidence as being absolutely unprejudiced, since Elliott Company also makes a complete line of steam turbines. You may be sure too, that where a generator is involved as well as an engine, the entire unit, Elliott-built throughout, will function as efficiently and harmoniously as is possible only with mechanical and electrical engineers working in close cooperation in a single organization.

Learn what 49 years of constant improvement have done for Elliott steam engines. Write us for the Steam Engine Bulletin.

ELLIOTT COMPANY

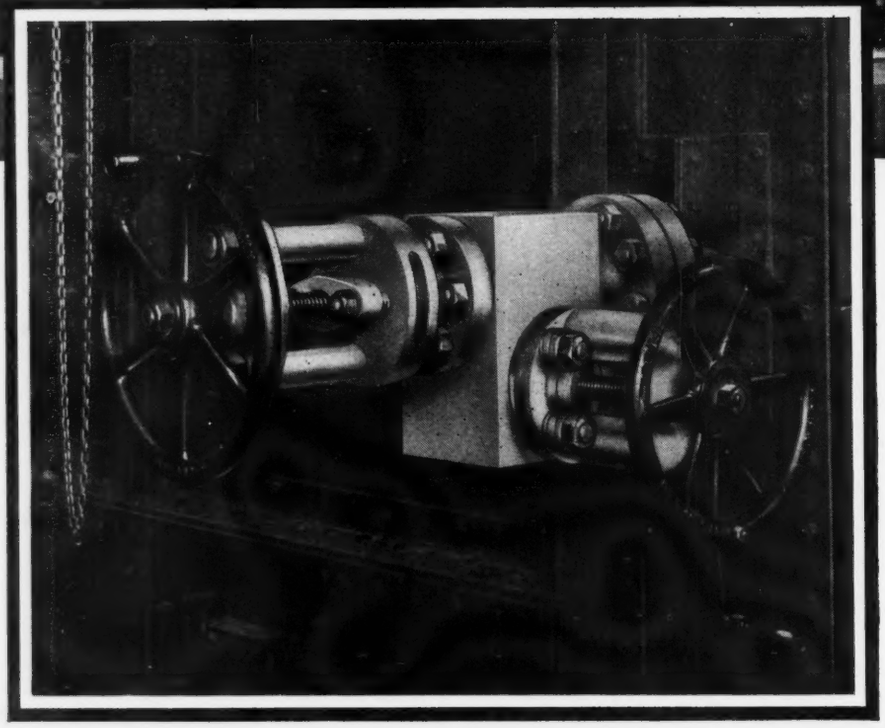
Steam Engine Dept.

RIDGWAY, PA.

District Offices in Principal Cities

460 Yarway Valves

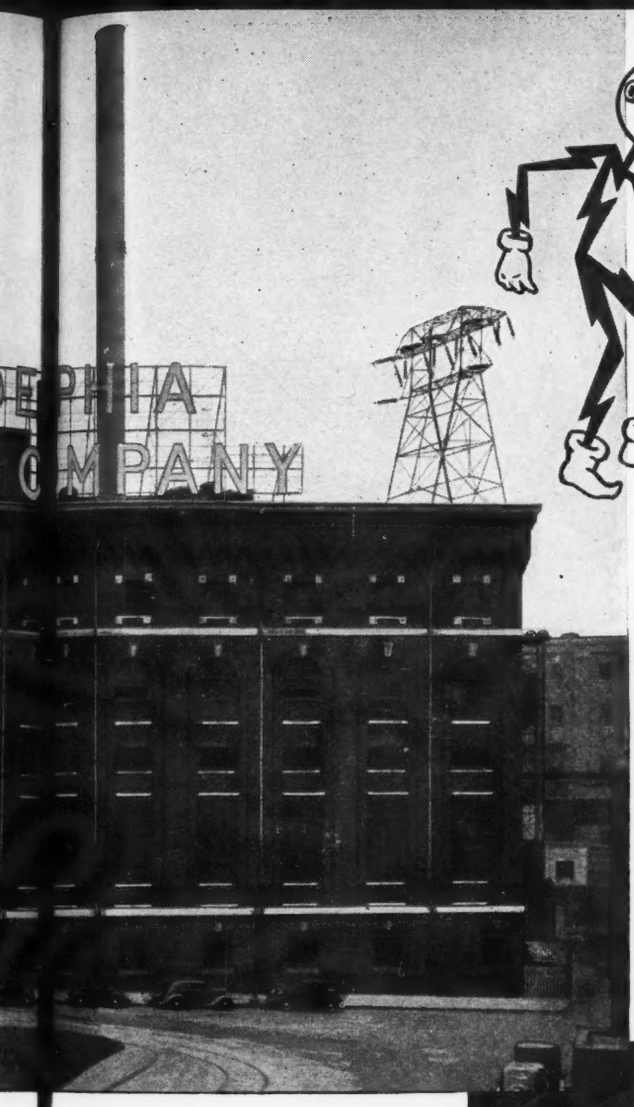
General view of Schuylkill Station of the Philadelphia Electric Co.



One of the four rugged Yarway Forged Steel Unit Tandem Blow-Off Valves on the main lower drums at Schuylkill Station.

YARWAY

at Philadelphia Electric



For Schuylkill Station's two new 1400 lb. pressure steam generating units—latest addition to this important system—Philadelphia Electric has again selected Yarway Blow-Off Valves, 28 forged steel valves in all.

Four of these valves are Yarway Unit Tandems used on main blow-down lines. Sixteen are Yarway Seatless Valves in tandem with eight Yarway Hard-Seat Valves used on water wall drain lines. All are the most modern types with flanged inlet and welding outlet connections.

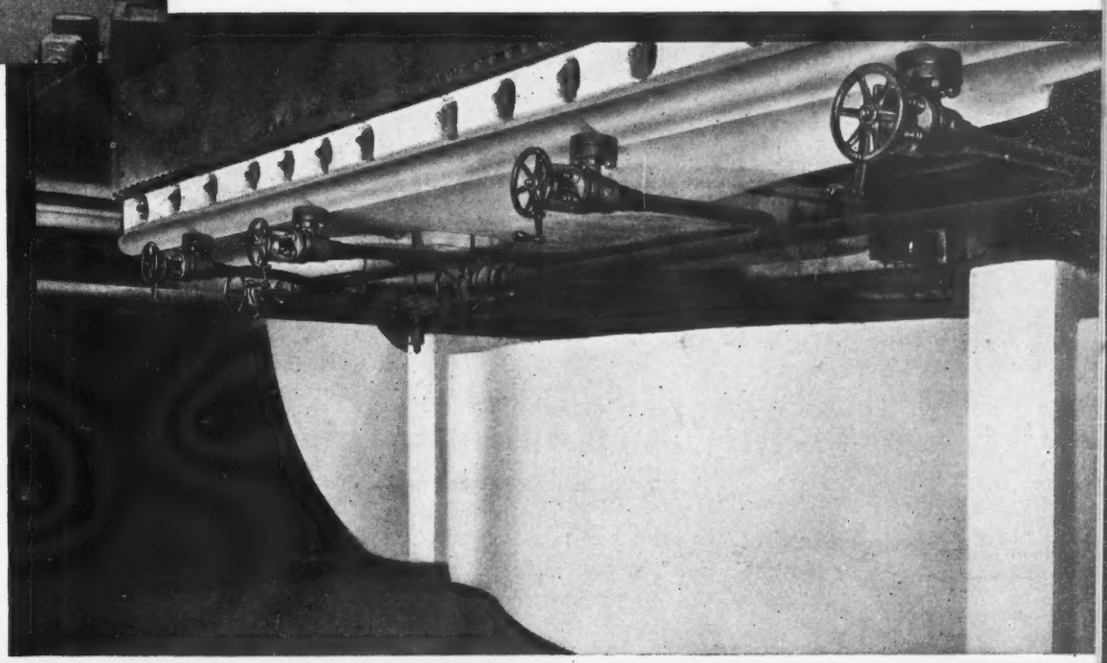
Philadelphia Electric first bought Yarway Valves 23 years ago and have reordered Yarways many times since then, for Richmond, Delaware, Chester and Schuylkill Stations, as load requirements have necessitated new plants and extensions to keep "Ready Kilowatt" ready for any demand.

Maintenance cost of these valves has been unusually low and the original valves purchased are still in service.

The experience of more than 12,000 Yarway Blow-Off Valve users — many, like Philadelphia Electric's, extending back over a quarter-century of service—are positive assurance of your satisfaction when you select Yarway Valves for your requirements on low, medium or high pressure service (up to 2,500 lbs.).

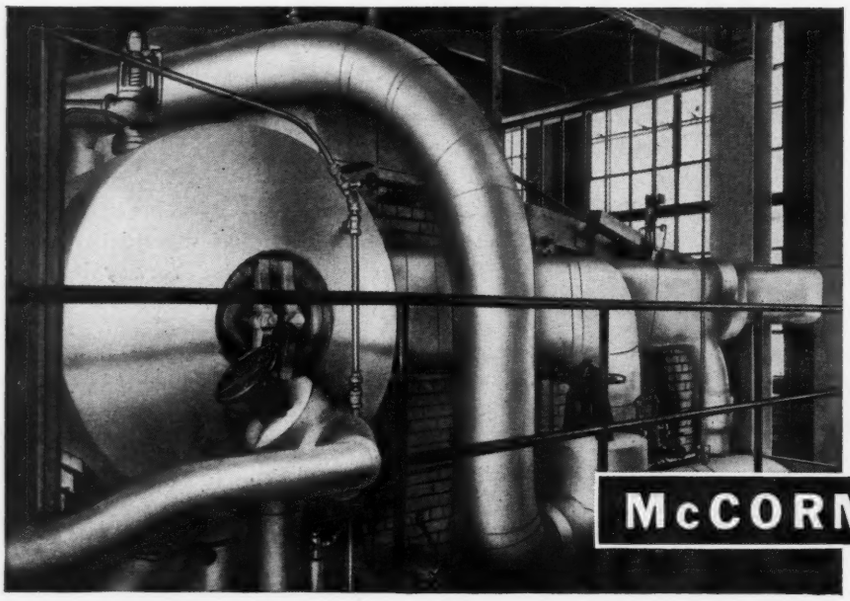
Ask for Catalog. Section B-420, up to 400 lbs. pressure. Section B-430, for higher pressures.

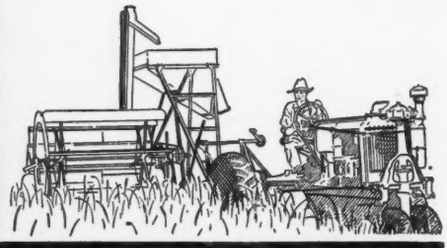
YARNALL-WARING COMPANY
100 Mermaid Avenue Philadelphia



Yarway Forged Steel Seatless and Hard-Seat Valves on water wall drains. There are 16 Yarway Seatless and 8 Hard-Seat Valves on water walls at Schuylkill Station. Note flanged inlet and welding outlet connections on all these valves.

BLOW-OFF VALVES





McCORMICK-DEERING

K & M insulation adds efficiency to International Harvester Co. power plant

To assure efficiency in the power plant at East Moline Works, International Harvester Company (Incorporated) installed K & M "Featherweight" 85% Magnesia insulation. This is one of the most efficient forms of heat insulation ever developed for use at temperatures up to 600° F.

The material was supplied by the Standard Asbestos Manufacturing Company of Chicago, K & M Distributors, who say: "The only way to judge insulation materials is by performance and that is our basis for selecting K & M as a line that we can fully stand behind. When we apply K & M products in our customers' plants, we know they will deliver high efficiency and stand up well in service, which are exactly the qualities our customers require."

K & M co-operates with its distributors by making available to users constructive engineering advice which frequently produces extra economies. For quality products and intelligent service, get in touch with your K & M Distributor.

K & M

"FEATHERWEIGHT"
85% MAGNESIA

"The Time-Proven Insulation"

KEASBEY & MATTISON COMPANY
AMBLER, PENNA.

District Sales Offices in principal cities

Starting as a tiny two-man business more than 65 years ago, The Keasbey & Mattison Company specialized from the start in Magnesia, and later in Asbestos products. Pioneering in insulation materials, it grew to an industry employing 2000 persons. It is a national institution with nation-wide facilities. As an innovator of improved materials and distribution, and of scientific product application, K & M is one of the manufacturing leaders of America.

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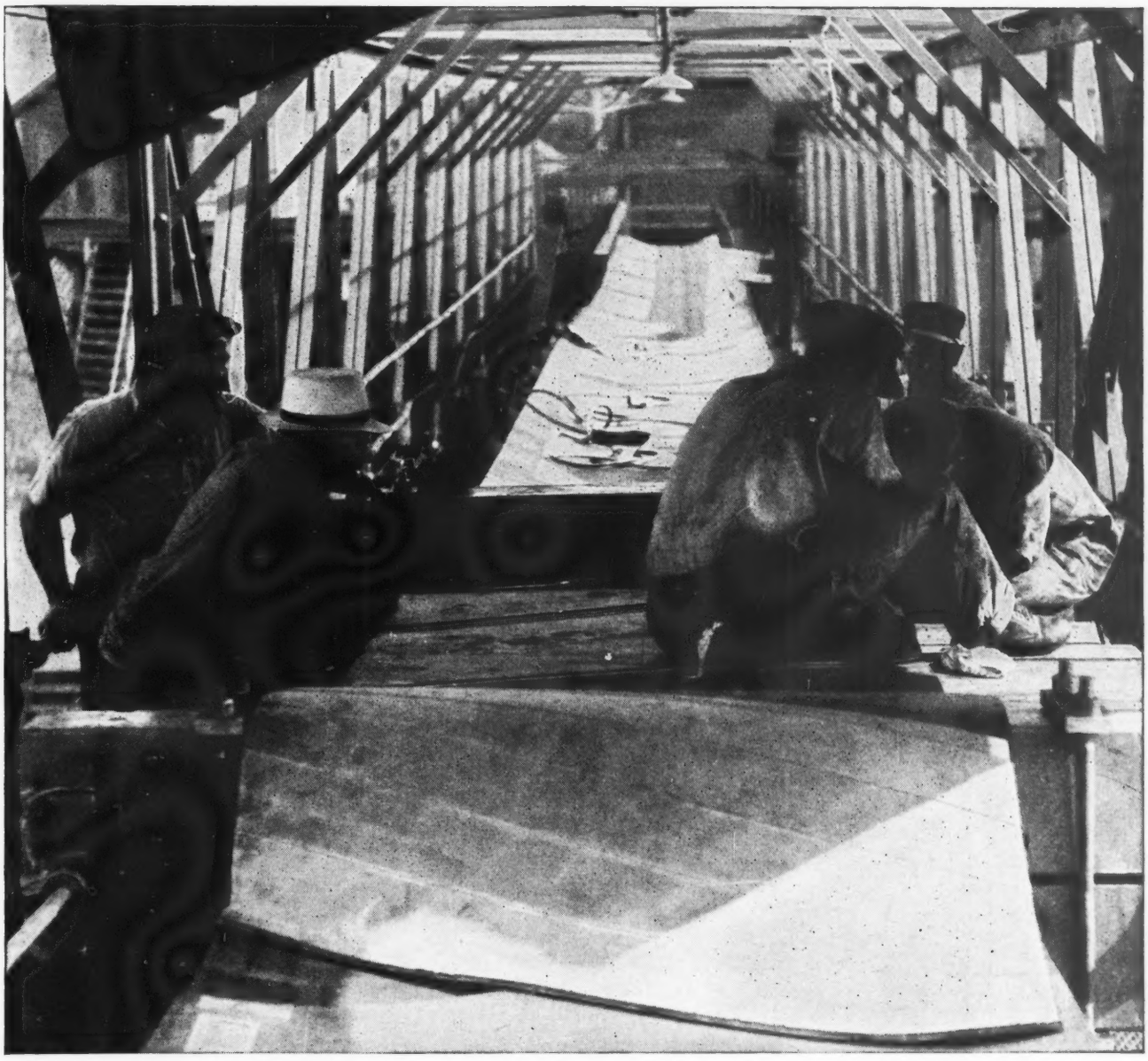


"Welding" a Rubber Band . . . 500 Feet Long

A typical example of Goodrich development in rubber

CONVEYOR belts for transporting coal, rock, materials of all sorts, used to have ends tied together with metal fasteners. But in severe service the fasteners pulled out, had to be replaced, tore ends of the belt, made frequent repairs and expense necessary.

Belts could be made endless at the factory, but were then too cumbersome to put over the pulleys on most installations. Goodrich engineers wanted a better way. They developed a splice which will not tear out—like welded steel it makes a joint that will last as long as the body of the belt itself. Then, working with a machinery maker, they developed a portable vulcanizer which can be transported easily, and "cures" the splice quickly.

Result is that a belt can be made endless *on the conveyor,* anywhere. Fasteners are done away with, maintenance cost is reduced, belt life is increased and often doubled or tripled.

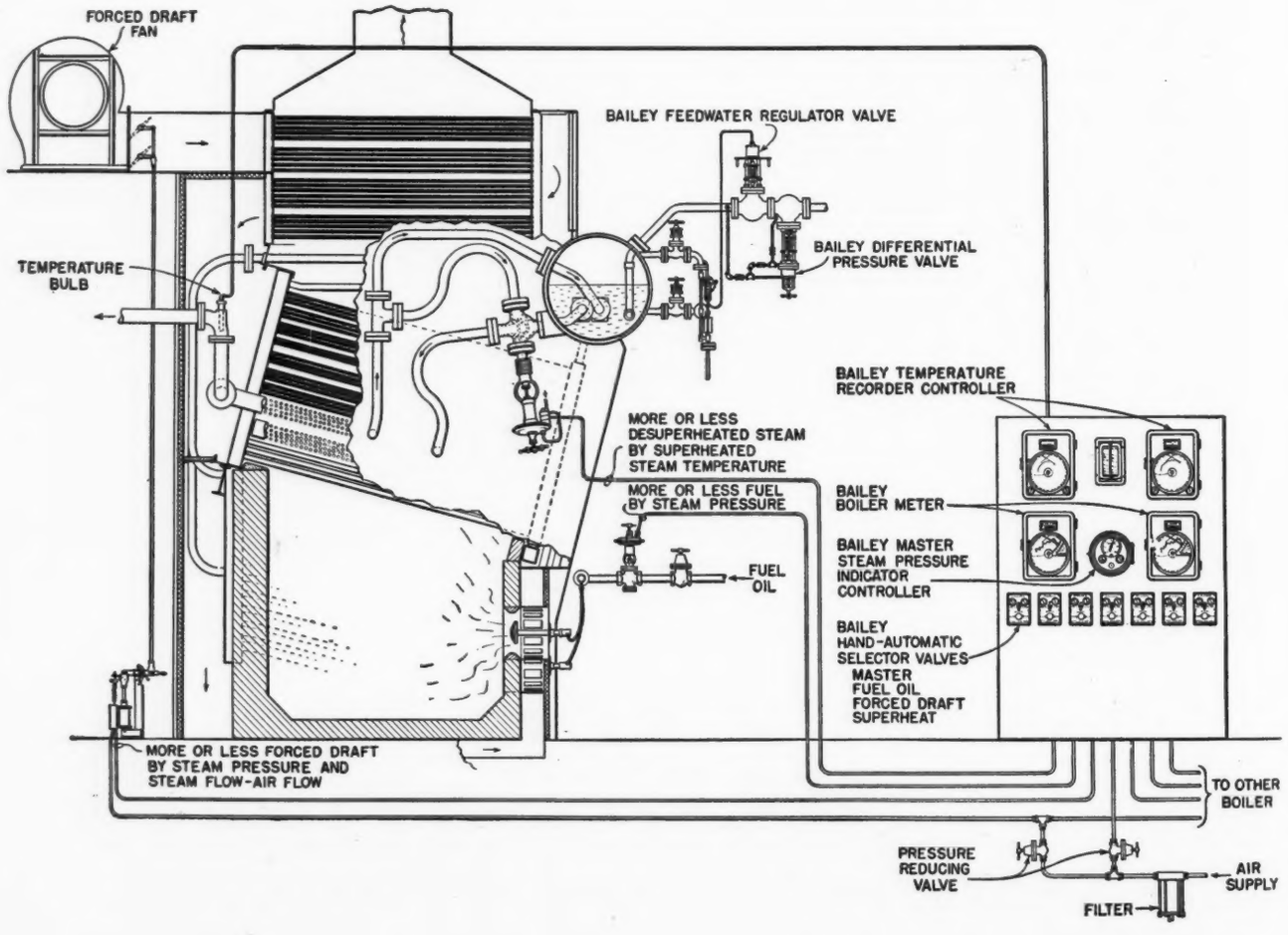
This is typical of the research which goes on every day at Goodrich—research which has developed tanks to hold even nitric acid, transmission belts which flex 5 times as long as former belts, hose which stands 20,000 pounds pressure, synthetics to resist oil, sunlight, oxidation. Specify Goodrich to your distributor, and you automatically secure, in any rubber product you buy, all the advantages and improvements of all this Goodrich development. If for any reason you can't get Goodrich products conveniently and promptly, please write The B. F. Goodrich Company, Mechanical Rubber Goods Division, Akron, Ohio.

Goodrich

ALL *products problems* IN RUBBER

Another story of Goodrich development work appears on the last page

S. S. Van Dyke CREDITS



Diagrammatic Layout of Bailey Meter Combustion and Feed Water Control Systems installed on New Tankers of The Atlantic Refining Co.

BAILEY METER CONTROL...

BOILER METERS • MULTI-POINTER GAGES • FLUID METERS • RECORDERS • SUPERHEAT

CONTINUOUS COMBUSTION ECONOMY TO *Bailey Meter Control*

Data from the log of the *J. W. Van Dyke*, Atlantic Refining Company tanker, show that in everyday operation this vessel maintains boiler efficiencies in excess of the manufacturer's guarantee and equal to those obtained during her trials.

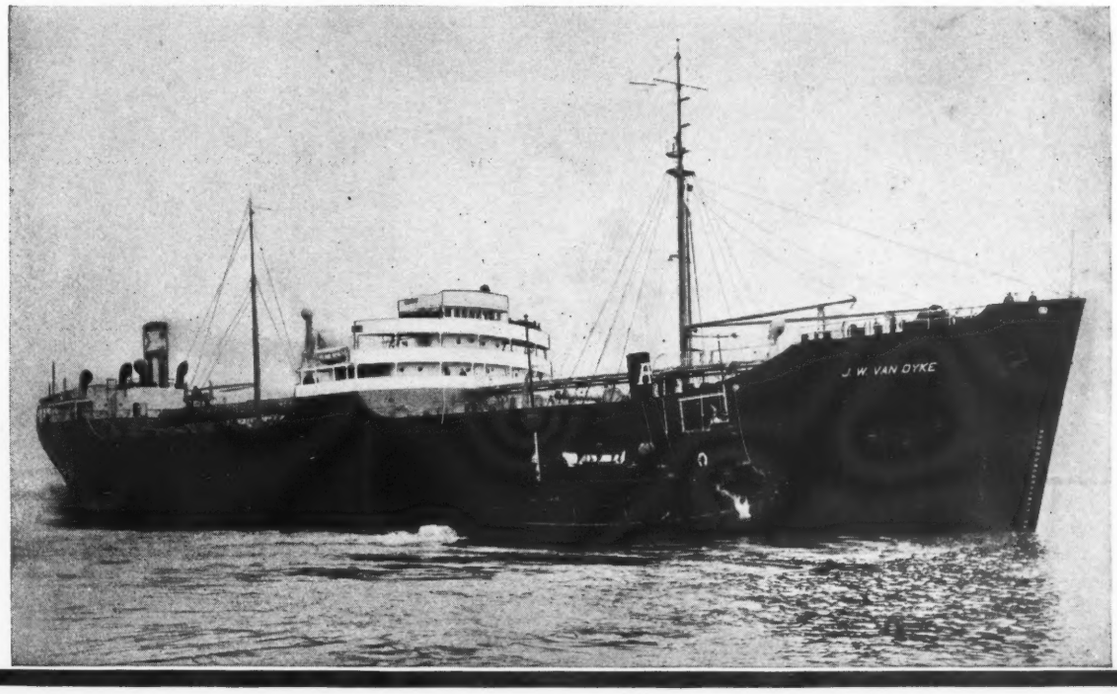
According to Mr. L. M. Goldsmith, Chief Engineer of the Atlantic Refining Company, such efficiencies can only be maintained by the almost perfect combustion conditions made possible by automatic combustion control.

Bailey Meter Control including automatic readjustment of fuel—air ratio by Bailey Boiler Meters and automatic control of superheated steam temperature, as installed on the S. S. Van Dyke and on her sister ship the Robert H. Colley, has been ordered for a third new Atlantic Refining Company tanker, now building.

Bailey Meters and Bailey Meter Control are equally well adapted to stationary service. Write for your copy of Bulletin No. 102-B.

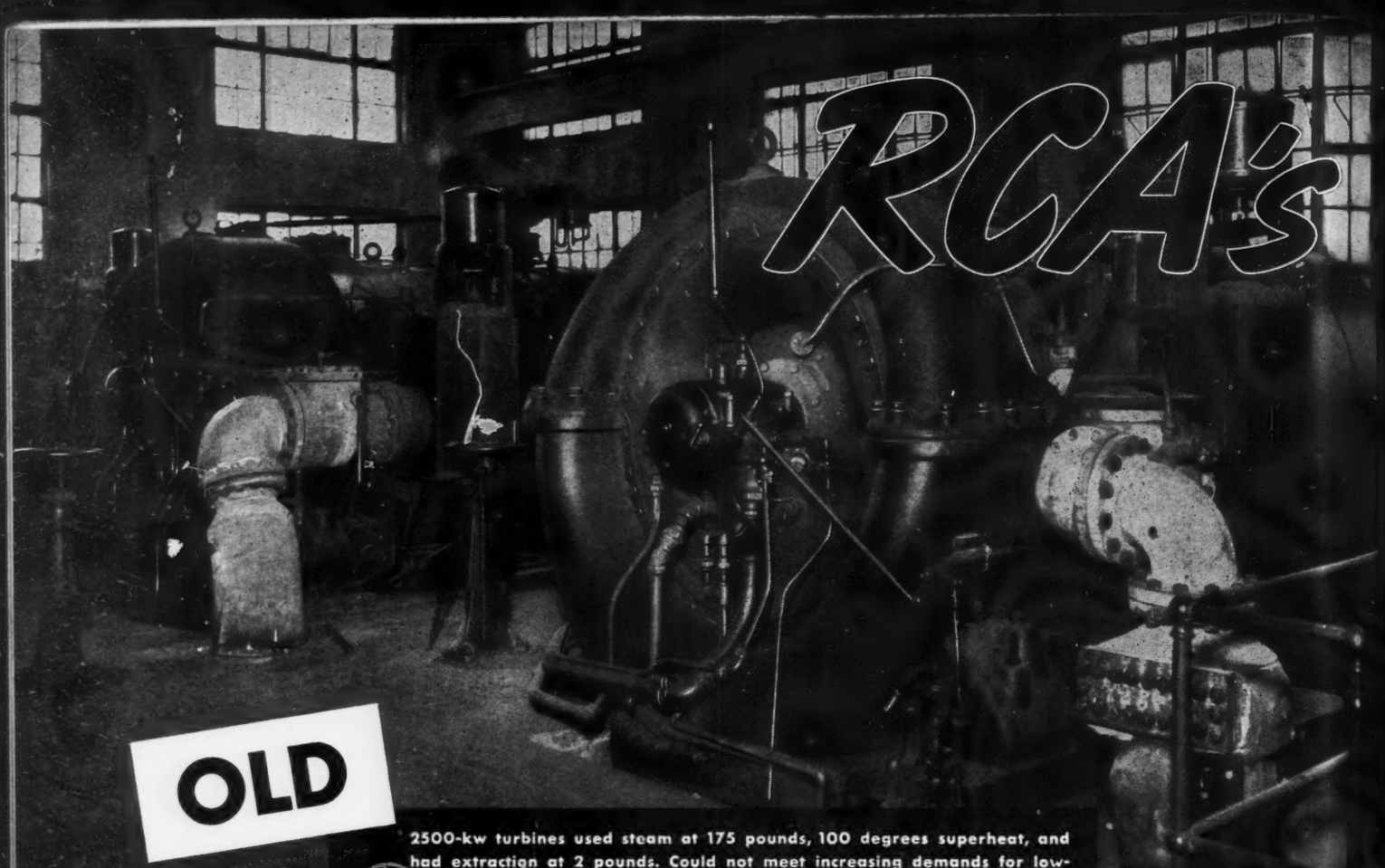
M-3

BAILEY METER COMPANY
1036 IVANHOE ROAD • CLEVELAND, OHIO
Bailey Meter Co. Limited, Montreal, Canada

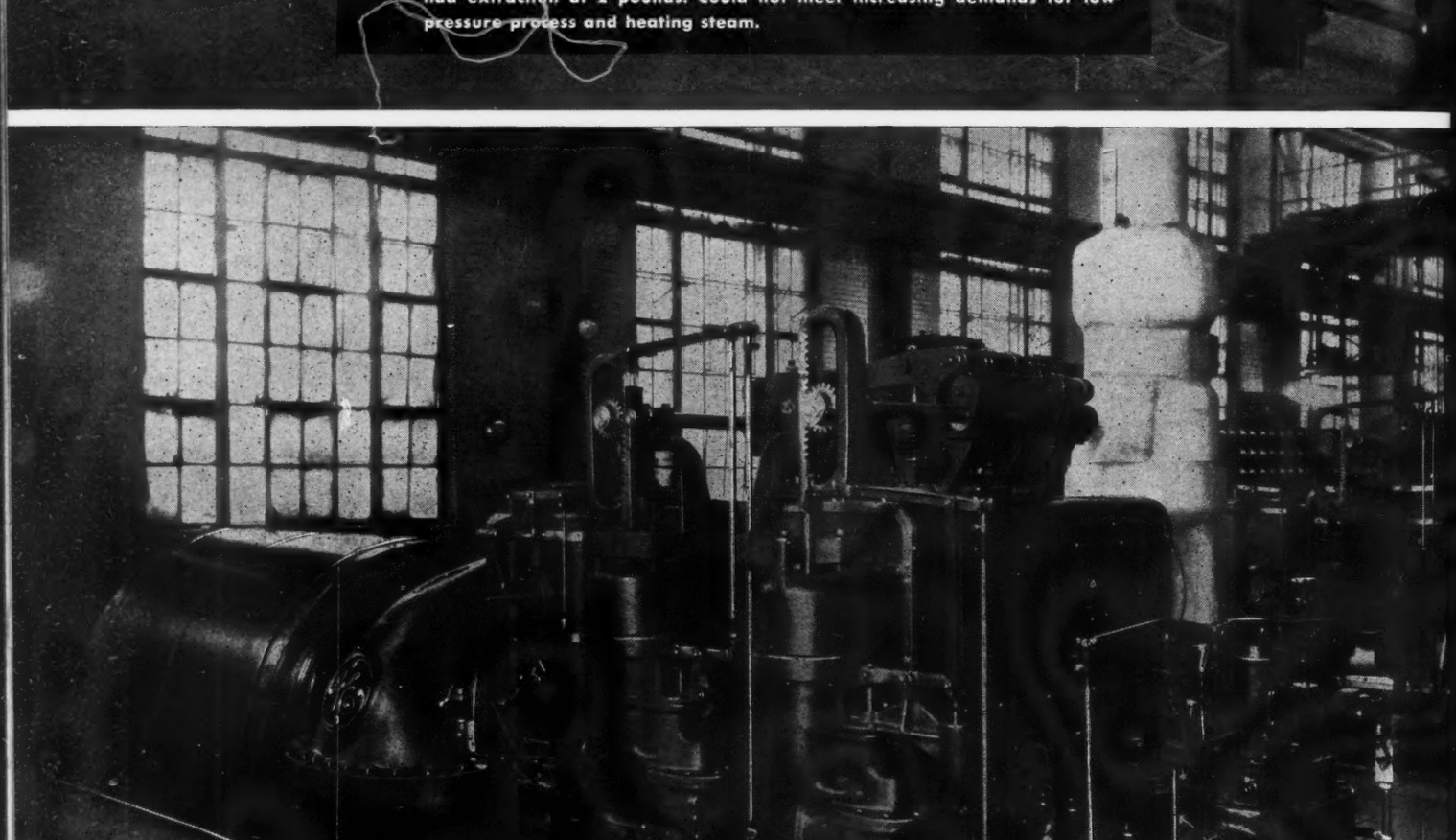


The Complete Combustion Control System

CONTROL • DESUPERHEAT CONTROL • COMBUSTION CONTROL • FEED WATER CONTROL



2500-kw turbines used steam at 175 pounds, 100 degrees superheat, and had extraction at 2 pounds. Could not meet increasing demands for low-pressure process and heating steam.



2500-kw G-E superposed double extraction turbines take steam at 900 pounds, total temperature 750 degrees. Extraction at 175 pounds supplies steam for two 3500-kw and two 1250-kw turbine-generators. Second extraction, in combination with extraction from 3500-kw turbines, provides ample steam for low-pressure process at 20 pounds.

MODERNIZATION PROGRAM Saves $125,000 Annually

TWO NEW GENERAL ELECTRIC TURBINES HELP TO IMPROVE PLANT EFFICIENCY AND REDUCE FUEL BILL

RCA Manufacturing Company, Inc., Camden, N. J.

SEVERAL months' operation of the modernized plant of RCA Manufacturing Co., Camden, N. J., shows that the improved turbine and boiler facilities will save enough in fuel costs alone to pay for the $750,000 program in six years. That's at the rate of $125,000 annually and is in addition to better operation and reduced repair and maintenance charges. This well-planned program shows how modernization can pay its way while increasing the operating efficiency of other sections of a manufacturing plant.

The RCA problem was one of efficiently supplying electric power for factory machinery and equipment and providing ample process and heating steam at two pressures. It was found that modifying only the steam-generating and turbine equipment would give the greatest improvement in operating economy per dollar invested.

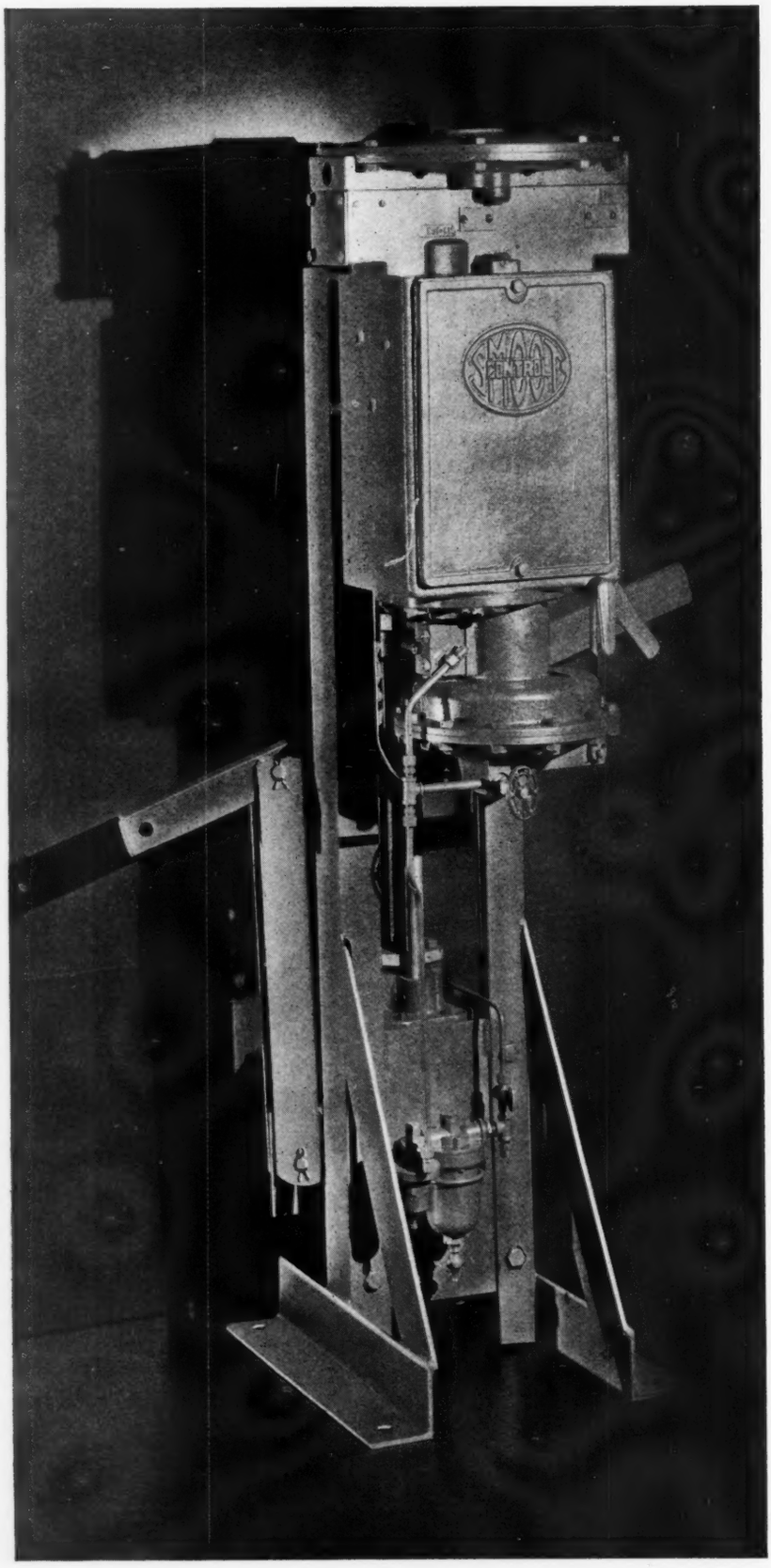
Two G-E 2500-kw, double-extraction turbine-generators were installed to take steam from the new boilers at 900 pounds and supply extracted steam at 175 and 20 pounds. When the plant electric load is heavy, the 175-pound steam drives four other turbine-generators of 3500-kw and 1250-kw capacities; at other times process requirements are great enough to use all the low-pressure steam. The entire plant is operating more efficiently; fuel savings are paying for the modernization.

Your plant may offer the same opportunity for profitable modernization. You can call a General Electric turbine specialist today and have him assist you in checking your turbine requirements. He may be able to suggest changes that will mean savings for you. Just call the nearest G-E office or write General Electric, Schenectady, New York.

GENERAL ELECTRIC

710-201

The Trend is to...



SMOOT REGULATOR APPLICATIONS

Pressure Control

Steam pressure control
Boiler furnace draft
Primary air pressure
Feed water pressure
Evaporator pressure
Process steam pressure
Blast air pressure
Exhauster suction
Fuel gas pressure
Suction main pressure

Flow Control

Water flow to desuperheaters
Water flow to condensers
Oil flow to boilers and furnaces
Gas flow to boilers and furnaces
Air flow to gas producers

Level Control

Hot well levels
Surge tank levels
Storage tank levels
Evaporator levels
Boiler water levels

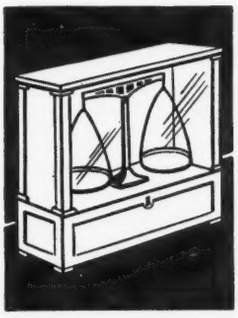
Speed Control

Stoker and fuel feeder speeds
Pulverizer speed
Pump speed
Fan speed
Steam turbine speed
Steam engine speed
Variable speed motors
Variable speed transmissions

View of a Smoot pneumatic type regulator, for controlling boiler air flow, mounted on stand with power cylinder.

SMOOT REGULATORS

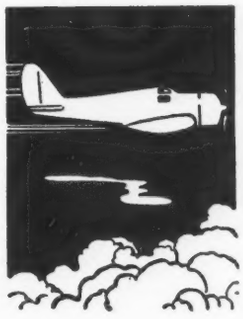
BECAUSE THEY MEET THESE FOUR ESSENTIALS OF GOOD REGULATION



Smoot Regulators can be made sensitive to changes of less than 0.001 of an in. of water.

SENSITIVITY

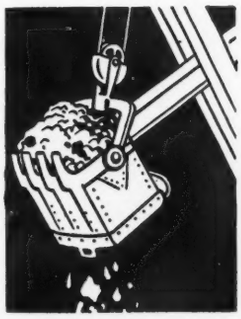
The amount of change that is required in the quantity being controlled to effect the regulator is the measure of its sensitivity. For close, accurate regulation, a regulator must be sensitive. It must respond immediately to the slightest deviation from the predetermined setting or the controlled quantity may vary far beyond the permissible limits.



Smoot Regulators will meet any speed requirement up to one full stroke in 2.4 seconds.

SPEED

The speed at which a regulator operates is an important factor in any control system. Any time lag between the variations in the controlled quantity and the operation of the control device to correct this variation, will produce an unnecessary error in regulation. A regulator, therefore, must be fast enough to follow the fastest load fluctuation.



Standard Smoot power cylinders will deliver from 360 foot pounds to 5,600 foot pounds per stroke.

POWER

A regulator must have sufficient power to not only operate the valve or other control device, but also to overcome any accidental friction or sticking that may occur in any part of the system. Insufficient power will cause failure in operation. It is for this reason that regulators are made with different size power cylinders, the smaller sizes being used for small valves and the larger sizes for the larger dampers and louvers.

The patented Smoot stabilizer will stabilize against any time lag in the operation of the equipment being controlled.

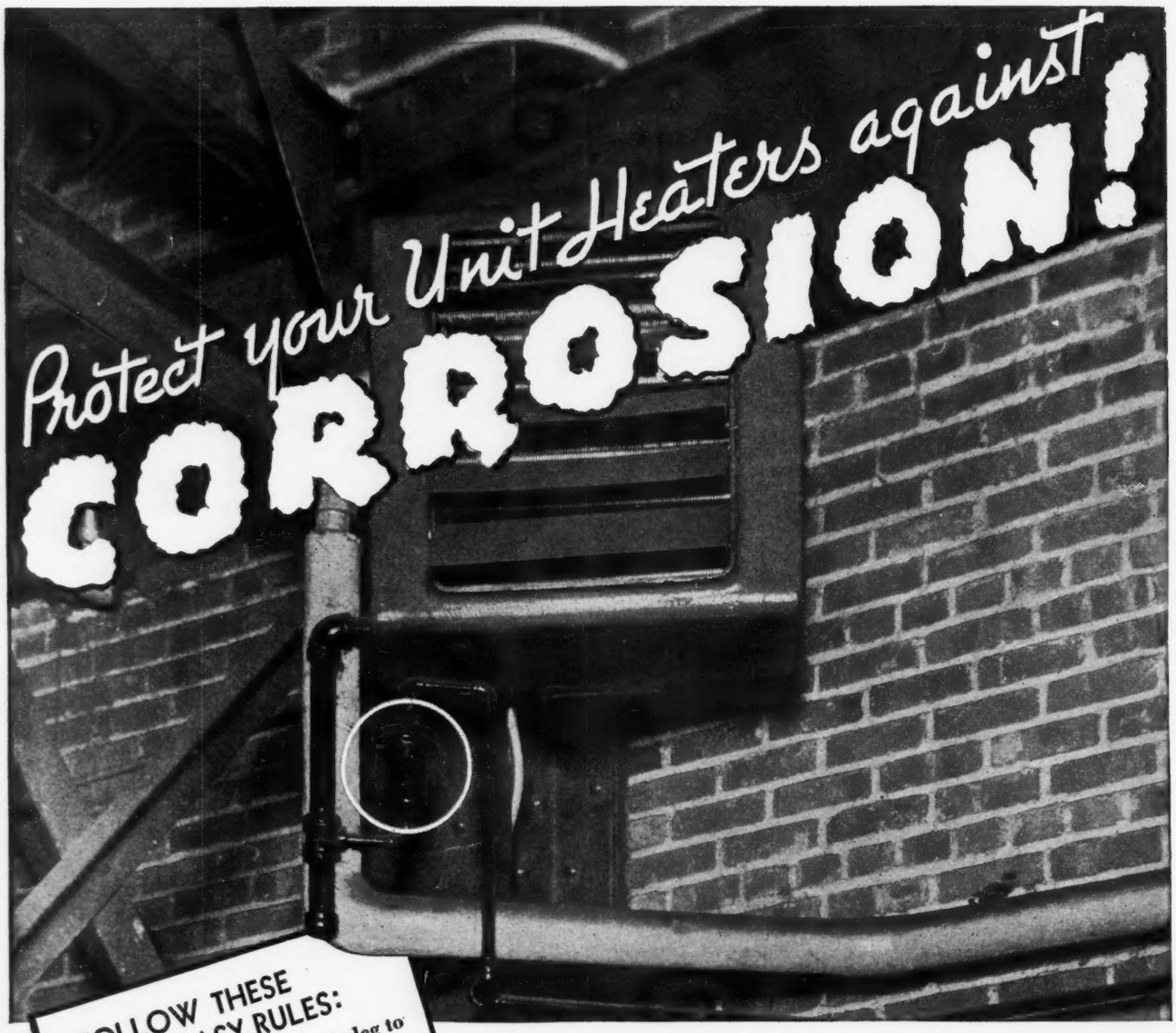
STABILITY

Stability refers to the ability of a regulator to maintain its balanced position or to return immediately to a balanced position if the controlled quantity is disturbed. There is always an interval between the time the valve or other control device is moved and the time the controlled quantity changes in response to this movement. Unless a regulator is stabilized it will tend to "hunt" or overtravel causing unnecessary variations.

Write For Data Book No. S-13

REPUBLIC FLOW METERS CO.

2222 Diversey Parkway ***Chicago, Illinois***



FOLLOW THESE EASY RULES:

1. Attach a short vertical drip leg to unit heater outlet. This provides a place to which condensate can drain by gravity when steam pressure is off.
2. Attach line to trap slightly above bottom of drip leg. This leaves an easily cleaned dirt pocket to catch scale and dirt.
3. Connect trap close to drip leg.
4. Use a trap that will discharge air rapidly, as well as water, and one that does not require condensate to cool before opening.
5. Use a trap with ample capacity.

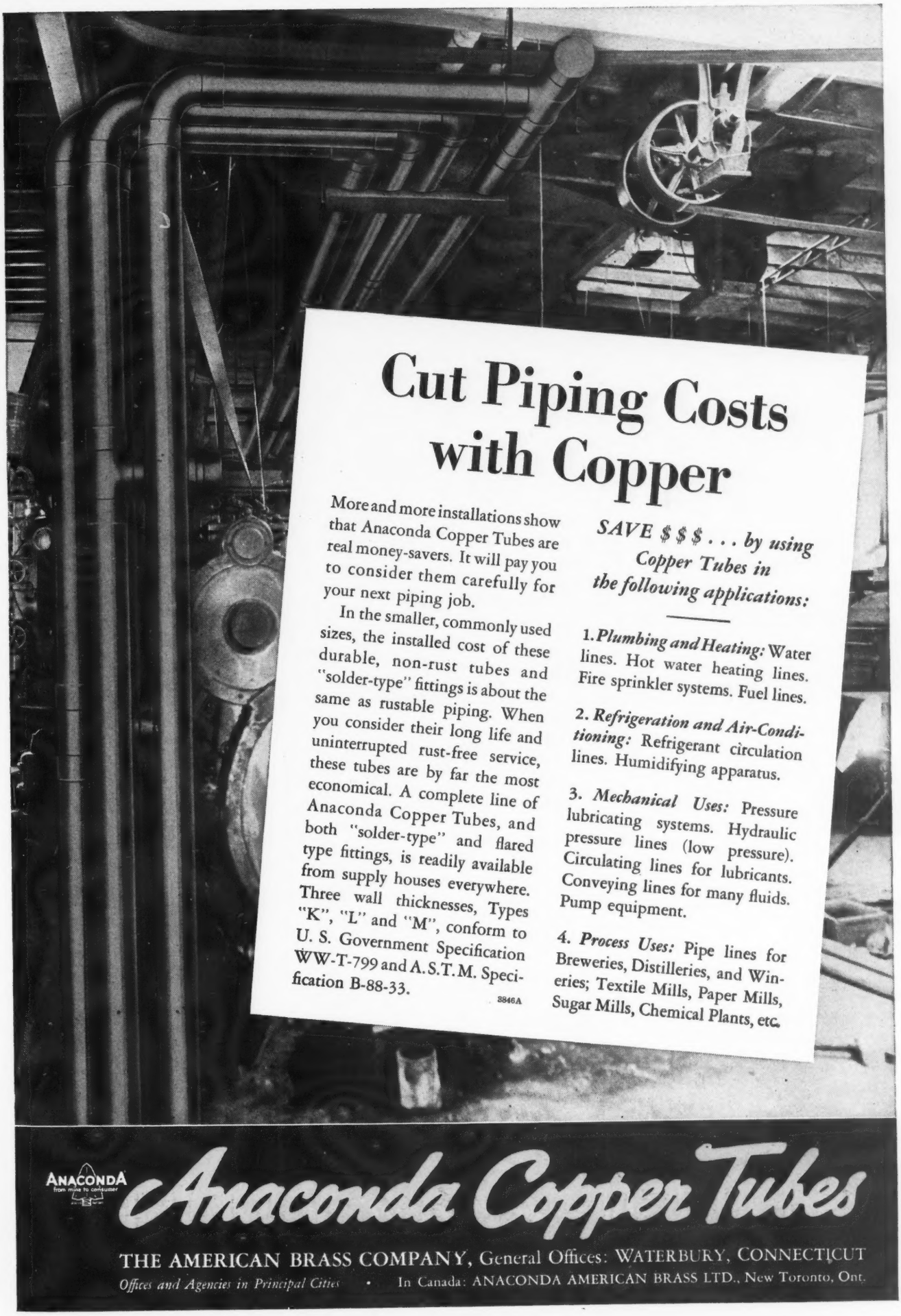
CORROSION in unit heaters is commonly caused by oxygen-laden condensate accumulating and standing in the lower sections. Such a condition can occur when the trap used has insufficient capacity or if it has to wait for the condensate to cool before discharging.

Corrosion is a serious matter because unit heaters are ordinarily built with thin coils to secure high rate of heat transfer and they cannot withstand prolonged attacks. This is why so many maintenance departments insist on Armstrong Traps.

Armstrong Traps guard against corrosion by assuring fast, positive removal of both condensate and air. Armstrong has complete tables for sizes of traps to use on all makes of unit heaters. *See your local Armstrong Representatives or write.* ARMSTRONG MACHINE WORKS, 812 Maple Street, Three Rivers, Michigan.

ARMSTRONG "INVERTED BUCKET" STEAM TRAP

ARMSTRONG Steam Traps



Cut Piping Costs with Copper

More and more installations show that Anaconda Copper Tubes are real money-savers. It will pay you to consider them carefully for your next piping job.

In the smaller, commonly used sizes, the installed cost of these durable, non-rust tubes and "solder-type" fittings is about the same as rustable piping. When you consider their long life and uninterrupted rust-free service, these tubes are by far the most economical. A complete line of Anaconda Copper Tubes, and both "solder-type" and flared type fittings, is readily available from supply houses everywhere. Three wall thicknesses, Types "K", "L" and "M", conform to U. S. Government Specification WW-T-799 and A.S.T.M. Specification B-88-33.

3846A

SAVE $$$ . . . by using Copper Tubes in the following applications:

1. ***Plumbing and Heating:*** Water lines. Hot water heating lines. Fire sprinkler systems. Fuel lines.

2. ***Refrigeration and Air-Conditioning:*** Refrigerant circulation lines. Humidifying apparatus.

3. ***Mechanical Uses:*** Pressure lubricating systems. Hydraulic pressure lines (low pressure). Circulating lines for lubricants. Conveying lines for many fluids. Pump equipment.

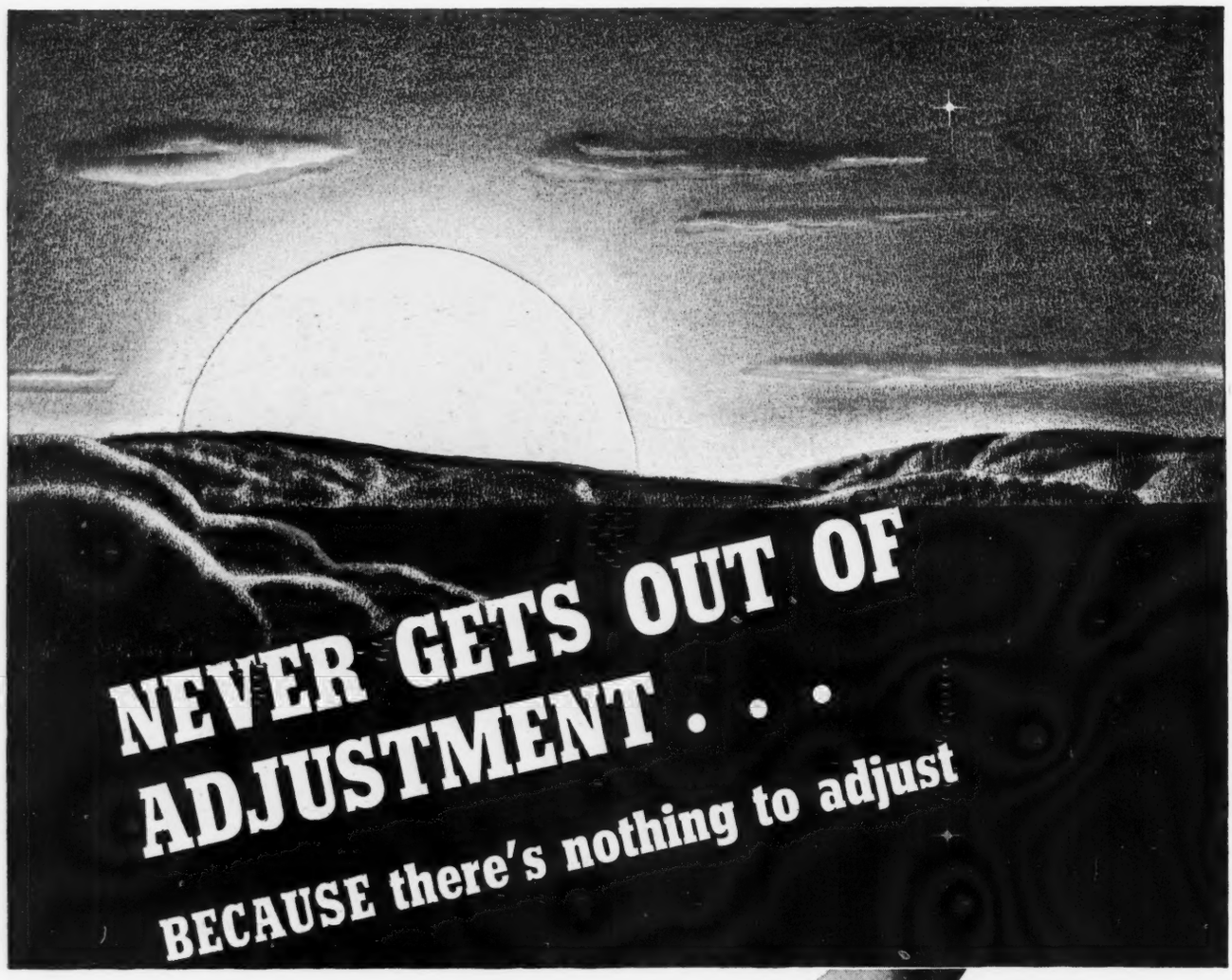
4. ***Process Uses:*** Pipe lines for Breweries, Distilleries, and Wineries; Textile Mills, Paper Mills, Sugar Mills, Chemical Plants, etc.

ANACONDA
from mine to consumer

Anaconda Copper Tubes

THE AMERICAN BRASS COMPANY, General Offices: WATERBURY, CONNECTICUT

Offices and Agencies in Principal Cities • In Canada: ANACONDA AMERICAN BRASS LTD., New Toronto, Ont.



NEVER GETS OUT OF ADJUSTMENT . . .

BECAUSE there's nothing to adjust

● The sun always rises in the East—and Sloan Royal Flush Valves work with equal certainty. In neither case is there anything to adjust, the operation being automatic.

Sloan Flush Valves, over a period of years, save an immense amount of water over all tank toilets, and very frequently over other types of flush valves. The reason for that lies in the design of Sloan Valves and the precision with which they are manufactured. Maintenance costs on Sloan Valves usually range between ½ and 1½ cents per valve—*per year.*

Reason enough why more Sloan Flush Valves are used than all other makes combined.

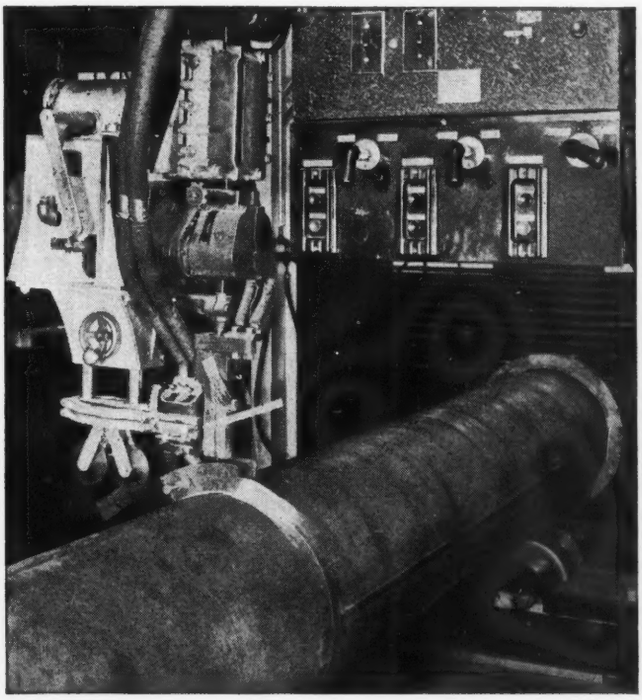
SLOAN VALVE COMPANY • CHICAGO

SLOAN *Flush* VALVES

MAKERS ALSO OF THE "STAR" "NAVAL" AND "CROWN" VALVES

More Power to You

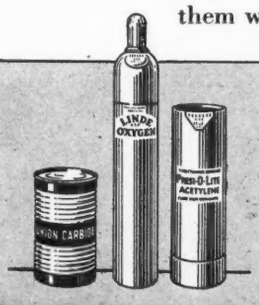
New Linde processes for fabricating pressure vessels and for joining pipe assure long, dependable service



UNIONMELT WELDING: A speedy, dependable, automatic welding process is now available in Unionmelt Welding — an electric welding process—which is shown here making a girth weld on a Par. U-68 (Class 1) type pressure vessel. This vessel has a wall thickness of 5/16 inch, and the weld was made in one pass at 19 inches a minute. Unionmelt welds have met the rigid specifications of the A.S.M.E. code for fired power boilers and of Par. U-68 (Class 1) for high-test type pressure vessels, and have been accepted by various insurance and inspection organizations.

LINDEWELD MULTI-FLAME PROCESS: Strong and tough welds of uniformly high quality can be obtained when piping systems are joined by the Lindeweld Multi-Flame Process which employs the new Oxweld 6- and 4-flame welding tips and high-speed welding rod. These welds, properly made, are permanently leak-proof and require no further attention. Also, they are ductile and are as corrosion-resistant as the pipe base metal. The Lindeweld Multi-Flame Process is fast and consumes a minimum of oxygen and acetylene in the installation of piping systems.

Many economical applications of these new Linde processes can be utilized by power consuming industries. Any Linde representative will gladly discuss them with you. Write the nearest Linde office for further information.



THE LINDE AIR PRODUCTS COMPANY

Unit of Union Carbide and Carbon Corporation

New York and UCC Principal Cities

In Canada: Dominion Oxygen Company, Limited, Toronto

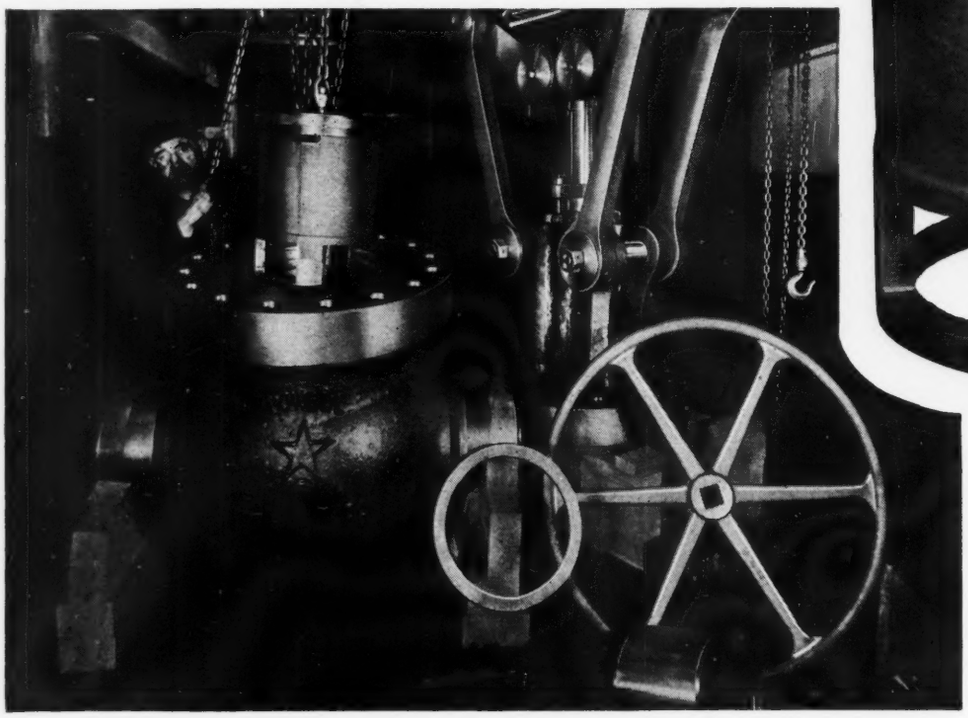
Everything for Oxy-Acetylene Welding and Cutting

LINDE OXYGEN • PREST-O-LITE ACETYLENE • OXWELD APPARATUS AND SUPPLIES • UNION CARBIDE

The words "Linde," "Prest-O-Lite," "Oxweld," "Lindeweld," "Union" and "Unionmelt" are trade-marks of Units of Union Carbide and Carbon Corporation.

Non-Galling and Long Wearing

At 1500 lbs. pressure... 900°F. Temperature



(Left) 12" toggle-operated non-return valve with welding ends for 1500 lbs. w.s.p. at 900° F. Mfd. by The WM. POWELL COMPANY, Cincinnati, O. Cylindrical guide for disc, and disc itself shown in foreground, are made of cast "S" Monel, heat treated to 320-350 Brinell. Insert above shows close-up of cylindrical guide.

"S" Monel proves ideal material for cylindrical guide liners, discs and seat rings

The working parts in the massive valve and toggle mechanism above must take the brunt of a working steam pressure of 1500 lbs., temperature of 900° F. The valve disc and its cylindrical guide parts are made of "S" Monel!

Experience has taught The Wm. Powell Company of Cincinnati, makers of these valves, that for cylindrical guide liners, discs and seat rings used in high-temperature service, "S" Monel is an ideal material. Its red heat hardness is over 300 Brinell at 1000° F. Also immune to rust and highly resistant to corrosion, non-galling "S" Monel withstands the corrosive and erosive action of live steam.

But that is not all. Tests made by The Wm. Powell Company's own metallurgists, on 23 different valve materials, prove that "S" Monel rates tops from the standpoint of economical dependability.

Where high-pressure, high-temperature operation causes undue corrosion, erosion and wear, specify "S" Monel. Use this enduring *high-temperature* alloy for freedom from trouble and long service life. Write for further information on "S" Monel. Address:

THE INTERNATIONAL NICKEL COMPANY, INC.

67 Wall Street New York, N. Y.

Monel INCO MONEL

"Monel" is a registered trade-mark of The International Nickel Company, Inc., which is applied to a nickel alloy containing approximately two-thirds nickel and one-third copper.

FOR 7 YEARS

Rings always Free!

Ports always Clear!

General view of Diesel plant in Hatfield, Pa. This plant has been 100% Texaco lubricated since 1931. Yearly inspections show rings free, exhaust ports clear, wear minimum.

•

Three Fairbanks-Morse Diesels in foreground. Two are 3-cyl., 2-cycle, 165 h.p. model 32. The third is a 2-cyl., 2-cycle, 120 h.p. model Y. Worthington 6-cyl., 4-cycle, 300 h.p. Diesel in background.

SINCE BUILT IN 1931, the Fairbanks-Morse, and later, Worthington Diesels in this Hatfield, Pa., plant have been lubricated 100% with Texaco Ursa Oil.

Year after year, they pull the pistons for annual inspection, only to find piston rings free in their grooves, exhaust ports clear. What little carbon found is soft and fluffy.

Wear is reported at a minimum . . . all this *after 7 years* with Texaco Ursa Oil.

For higher lubricating efficiency in *your* plant, get in touch with Texaco. Trained lubrication engineers offer their help in selecting and applying the right lubricants, and prompt deliveries are assured from 2186 warehouses. Write or phone the nearest one, or:

The Texas Company, 135 East 42nd Street, New York City.

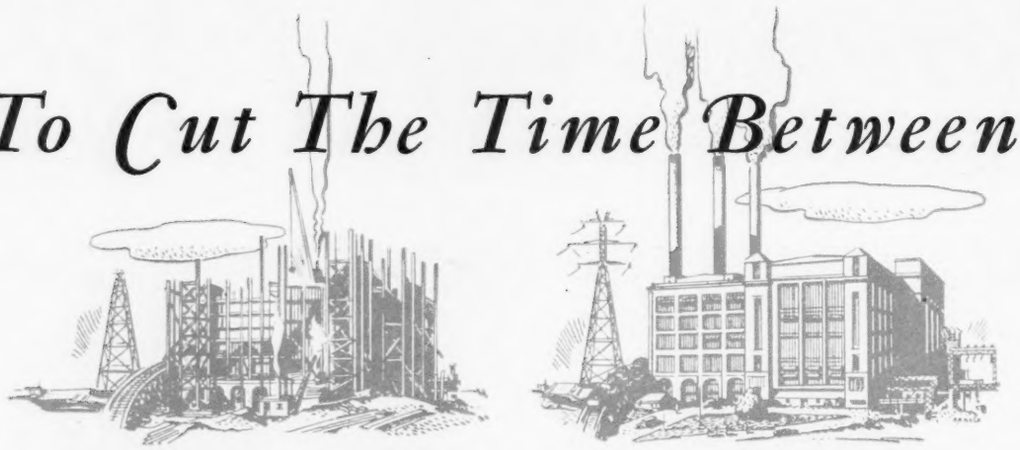
DIESEL OPERATION *is the title of Texaco's 80-page treatise. Every Diesel operator should have a copy among his plant books. Yours for the asking.*

TEXACO

URSA OIL FOR DIESELS

Texaco Dealers invite you to tune in The Texaco Star Theatre—a full hour of all-star entertainment—Every Wednesday Night — Columbia Network — 9:00 E.S.T., 8:00 C.S.T., 7:00 M.S.T., 6:00 P.S.T.

To Cut The Time Between



INVESTMENT *and* RETURN

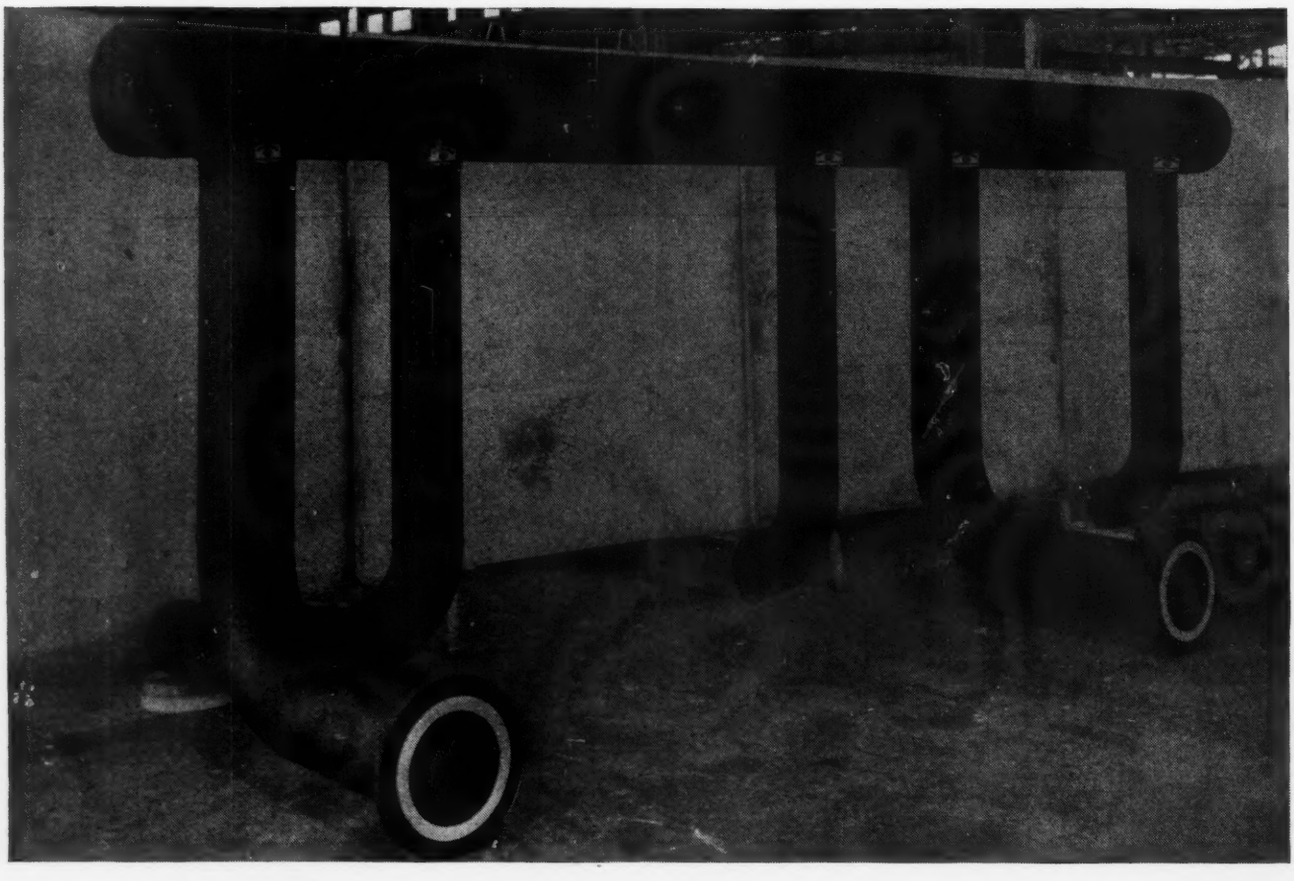
Once the plans are approved, the materials specified and construction begun on your new power plant or process lines, *every day counts.* Your new installation will be more efficient, will return larger profits than the old one — *but not until it is in operation!*

Grinnell Prefabrication provides a sound, tested short-cut to quick erection. Accurate sub-assemblies, prefabricated to specifications, are easily and economically field-welded into a finished piping system, ready for use.

Grinnell's advanced plant facilities, strategically located for service to the East, Central, South and Western parts of the continent . . . Ability to interpret ideas and plans into piping . . . Qualified welders and experienced shop men are among the reasons why it pays to "Give the plans to Grinnell!" Grinnell Co., Inc., Executive Offices, Providence, R. I., Branch offices in principal cities.

PREFABRICATION BY **GRINNELL**

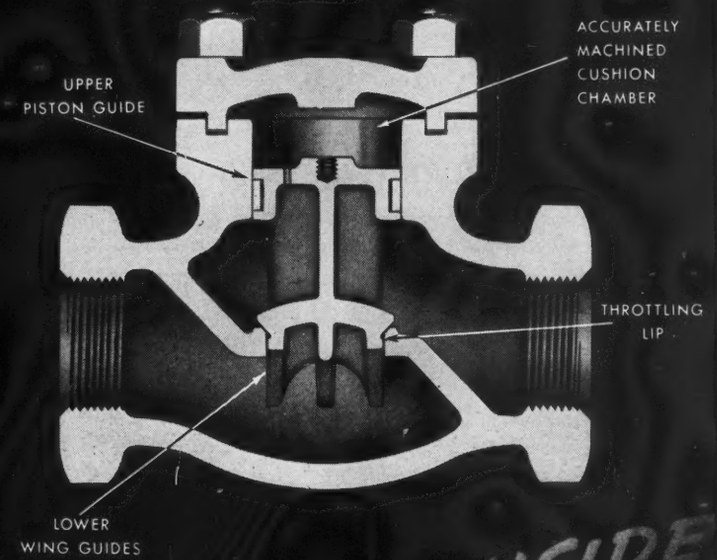
WHENEVER PIPING IS INVOLVED



CUSHIONED CHECK VALVES

for Unusual Service IN POWER PLANTS AND FACTORIES

Crane No. 1507½ Ferrosteel Cushioned Check Valve. Cross section shown below.



IT'S WHAT'S INSIDE THAT COUNTS!

Step out into the plant—any plant, on process lines—power lines—wherever the flow of liquids and gases is controlled, you will find check valves. Their function—preventing dangerous back flow—is most vital in many piping systems. And because the conditions which they must meet vary widely, check valves deserve more care in selection than valves of any other type.

Regardless of the service, there is a Crane Check made to meet just those conditions. For example, consider those lines where pulsations in flow or intermittent service cause a serious slamming of the disc, which quickly destroys valves or necessitates extensive repairs. Here the Crane Cushioned Check offers distinct advantages. It freely permits flow, but cushions the pulsations and permits long, economical service. Every Crane Check has back of it the Crane resources of skilled engineering, extensive laboratory tests, quality manufacture and careful inspection.

When you need check valves, be sure to get the recommendation of the Crane Representative. Also, ask him for a copy of "Checking up on Check Valves," Crane's new booklet, which will be a real help to you in understanding the many different types of check valves and in selecting the correct type for the service you require.

CRANE

VALVES • FITTINGS • PIPE • PLUMBING • HEATING • PUMPS

CRANE CO., GENERAL OFFICES: 836 S. MICHIGAN AVE., CHICAGO

NATION-WIDE SERVICE THROUGH 134 BRANCHES AND MORE THAN 500 WHOLESALERS

THE OIL SEAL THAT RESISTS OIL *and* HEAT

PATENTED

SPLIT-KLOZURE

To meet the need for an Oil Seal that can be installed around the shaft rather than over the end of the shaft, Garlock has developed the new patented SPLIT-KLOZURE. For all shafts of 3" diameter and larger.

The Garlock **KLOZURE** sealing ring is molded from an exclusive Garlock compound developed specially for oil seal service. It is non-porous, non-abrasive, resilient, tough and durable . . . does not become soft or flabby in service . . . *resists* oil and heat. The KLOZURE Oil Seal is furnished in a complete range of sizes. Write for catalogs.

THE GARLOCK PACKING CO., PALMYRA, N. Y.
In Canada: The Garlock Packing Co. of Canada Ltd., Montreal, Que.

Garlock KLOZURE

PIPING BY
MIDWEST

Precision Pre-Fabrication
SAVES YOU MONEY

Everybody knows that precision pays . . . that parts which fit immediately save so much money in assembly that any other kind are prohibitive in cost.

Precision in piping also pays. Piping by Midwest is pre-fabricated into a series of sub-assemblies which fit together precisely . . . which make erection a matter of relatively few field joints. Savings of time and money are obvious. In addition, the resulting piping job is superior.

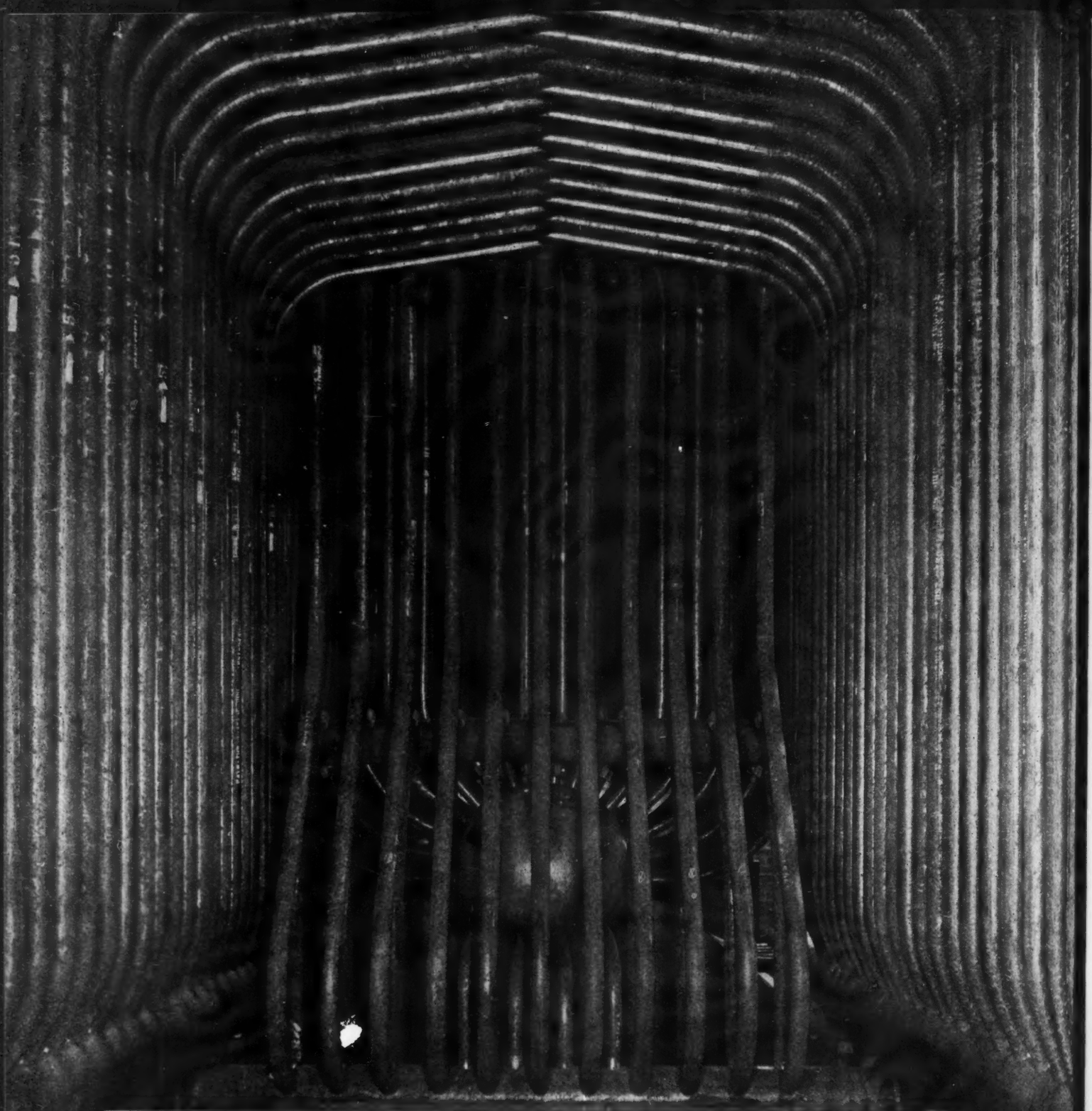
Midwest Piping is pre-fabricated in modern plants, by skilled piping specialists, under controlled manufacturing conditions. Proper machinery is available to assure quality work; welders and other workmen are well trained. The work is directed by men of long experience in every type of piping.

Call on Midwest for Piping—no matter how small or how large the job.

MIDWEST PIPING & SUPPLY CO., INC.

Main Office: 1450 So. Second St., St. Louis, Mo.

Plants: St. Louis, Passaic (N. J.) and Los Angeles • Sales Offices: Chicago—946 Marquette Bldg. • Houston—1716 Second National Bank Bldg. • Los Angeles—520 Anderson St. • New York—(Eastern Division) 30 Church St. • Tulsa—533 Mayo Bldg.



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ELECTRUNITE

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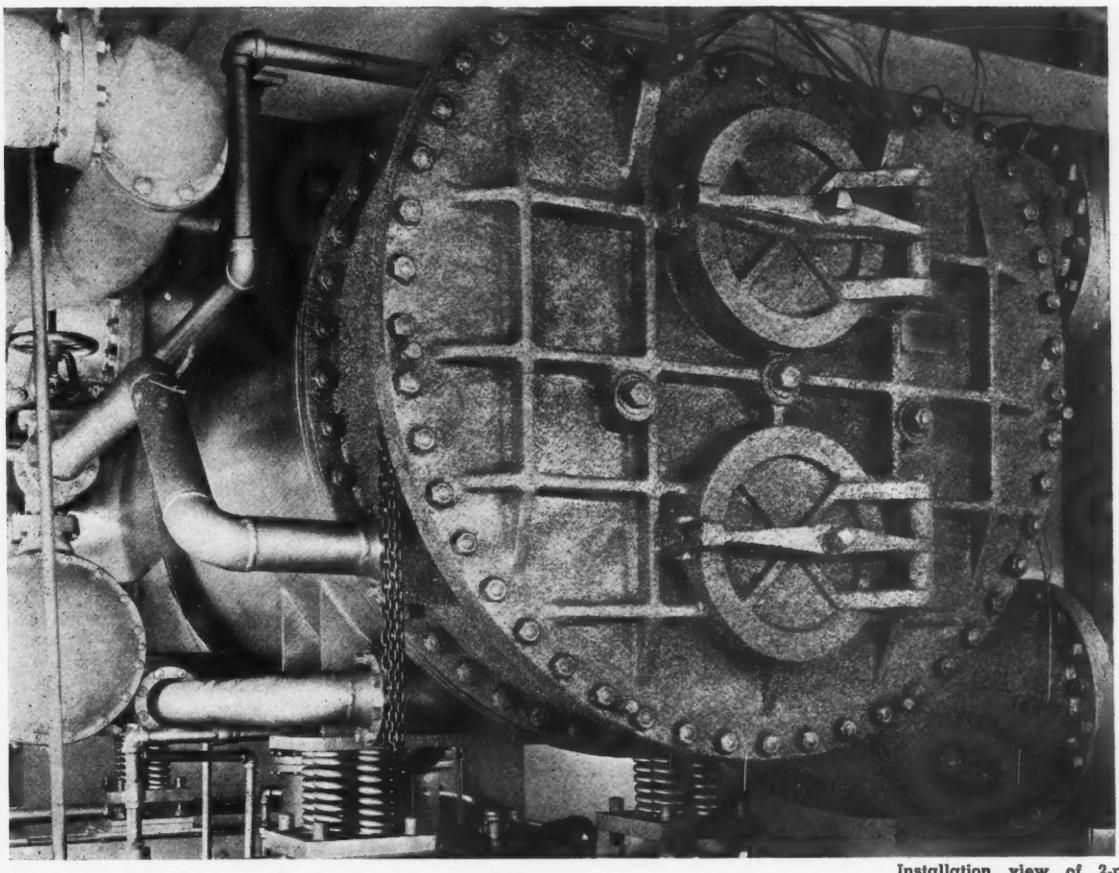
STEEL AND TUBES ELECTRIC WELD

BOILER TUBES

If you were unable to visit the ELECTRUNITE exhibit at the Power Show, you can learn all about the many features of this modern boiler tube from your nearest ELECTRUNITE distributor. • Ask him to tell you why each year more users are turning to ELECTRUNITE—or write us for this information. Steel and Tubes, Inc., Cleveland, Ohio. (Subsidiary of Republic Steel Corporation.)

ONLY IN ELECTRUNITE WILL YOU FIND ALL OF THE ADVANTAGES AVAILABLE IN THIS MODERN BOILER TUBE

EFFECTIVE CONDENSERS



Installation view of 2-pass condenser with external air cooler; total surface, 5000 square feet.

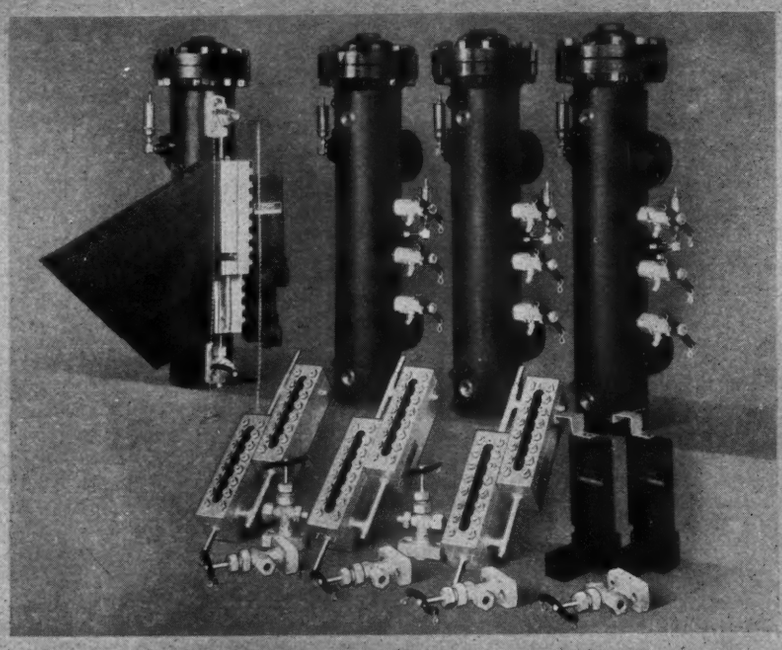
Penetration

EVERY TUBE in a modern condenser must condense its share of the entering steam in order to obtain maximum efficiency. Long research and calculation based upon practical operating results provide tube layouts with differential spacing of radiating straight lines converging toward the bottom of the condenser. The straight steam lanes thus provided insure even distribution of steam to each tube with minimum pressure loss and, therefore, maximum opportunity for heat transfer.

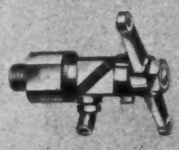
PROGRESSIVE developments over 45 years of condenser manufacture have greatly reduced the amount of condensing surface formerly used to effect and maintain high vacuum. The savings in water circulated, pumping costs and space required provide a collective reduction of major importance in the original investment as well as operating expense.

FOSTER WHEELER CORPORATION, 165 BROADWAY, NEW YORK, N. Y.

FOSTER WHEELER



Reliance No. 302 Forged Steel Gage Cocks, pressures to 2000 pounds.



Reliance Fused Monel Float, guaranteed unsinkable.

Reliance Weighted Gage Cock, pressures to 250 lbs., chain open—self close.

Reliance No. 301 Standard Gage Cocks, pressures to 450 pounds.

Reliance EYE-HYE Remote Reading Liquid Level Indicator.

More Earning "Power"

Reliance Safety protects this other vital profit force you want from your power plant. Conserve it—keep power flowing efficiently—avoid wasteful accidents and shut-downs with Reliance Custom Made Boiler Safety Devices and Accessories, relied on for 54 years by thousands of engineers proud of their plants.

Write for information today.

THE RELIANCE GAUGE COLUMN COMPANY
5902 CARNEGIE AVE. • CLEVELAND, OHIO

Reliance
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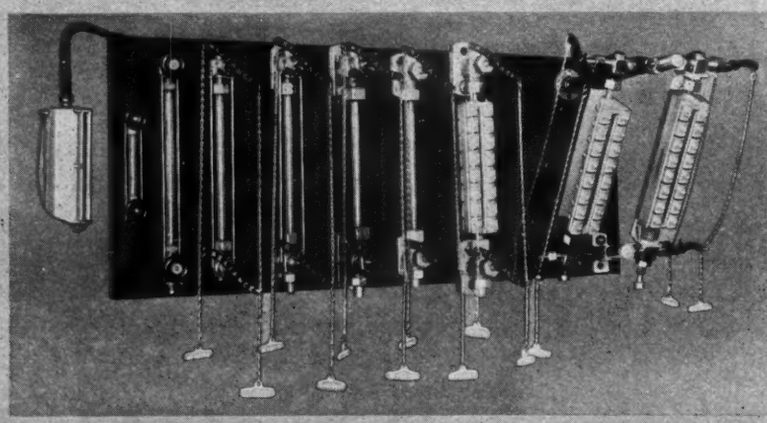
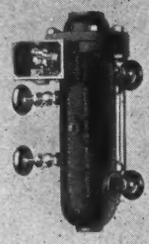
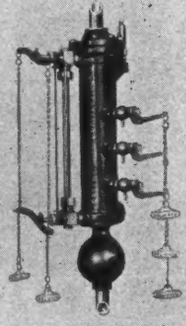


Reliance Micasight Water Gage Insert, pressures to 2000 pounds.

Reliance Prismatic Water Gage Insert, pressures to 450 pounds.

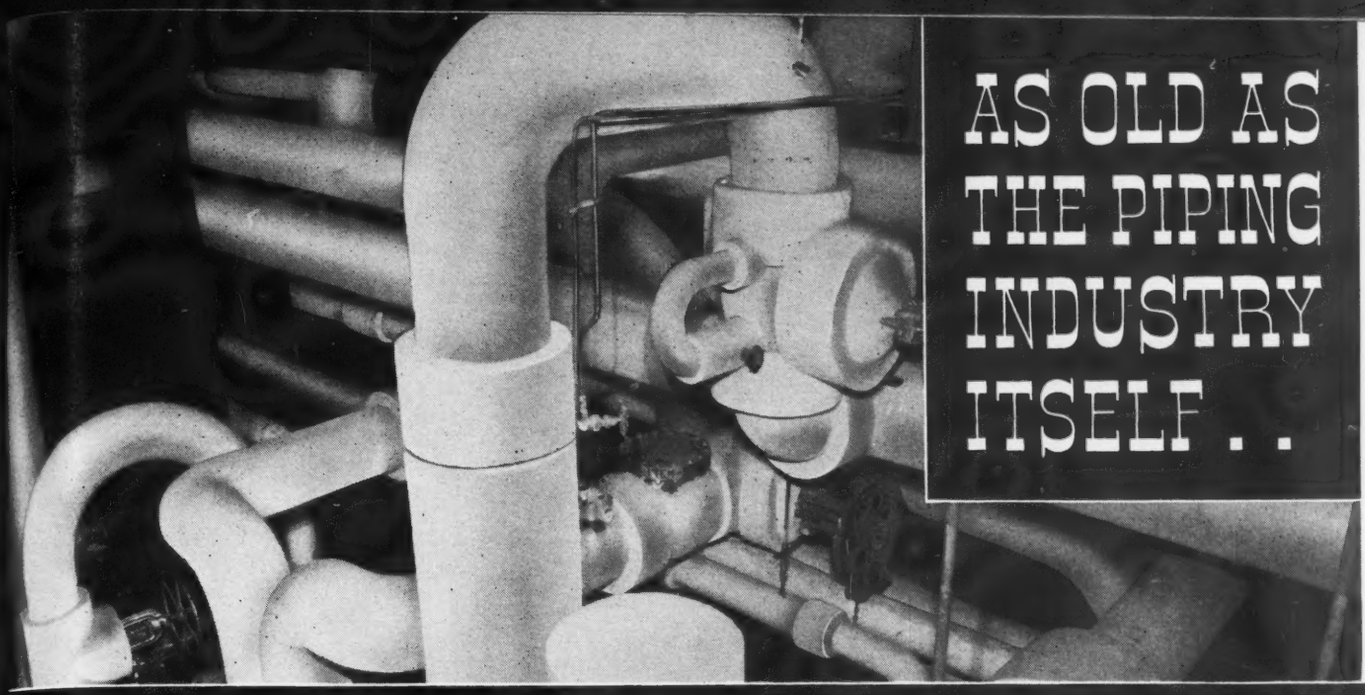


Reliance Low Water Alarm equipped Reliance mercury-type electric switch.



Reliance No. 5 High and Low Water Boiler Alarm, pressures to 250 pounds.

Boiler Safety Devices Since 1884



AS OLD AS THE PIPING INDUSTRY ITSELF . .

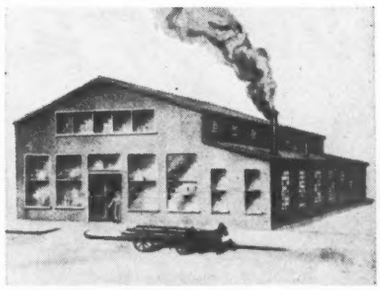
THIRTY-FIVE YEARS OF ACHIEVEMENT

IN PIPING PRE-FABRICATION AND ERECTION

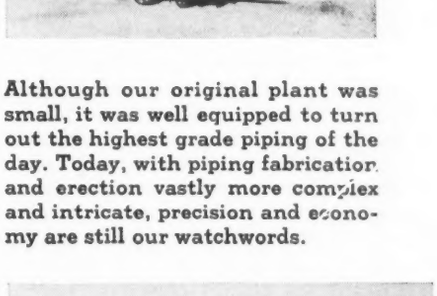
EVEN though the piping requirements for the power and process plants of 35 years ago were relatively simple, Pittsburgh Piping was one of the first to recognize the many advantages of pre-fabricating as much of the piping as possible under controlled shop conditions. Today, every conceivable method of pipe fabrication to meet widely varying installations is embraced within the scope of our activities.

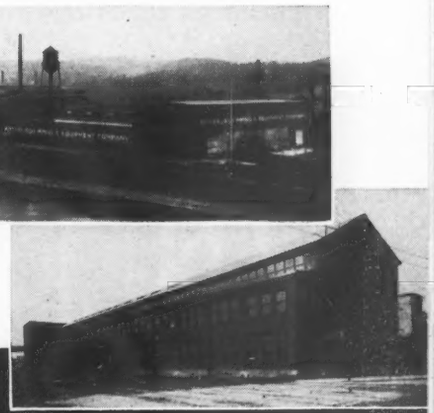
The record of our achievement is written throughout the country by the many piping installations, both large and small, that set new standards for greater pressures, higher temperatures and more intricate fabricating. This has been made possible only by anticipating future trends and being prepared to fabricate and erect piping to meet new requirements.

Whether your piping program calls for a complete system or the extension of existing lines, knowledge accumulated since the beginning of the piping industry, mature experience and adequate facilities are your assurances that it will be fabricated and erected with precision and economy.



Although our original plant was small, it was well equipped to turn out the highest grade piping of the day. Today, with piping fabrication and erection vastly more complex and intricate, precision and economy are still our watchwords.



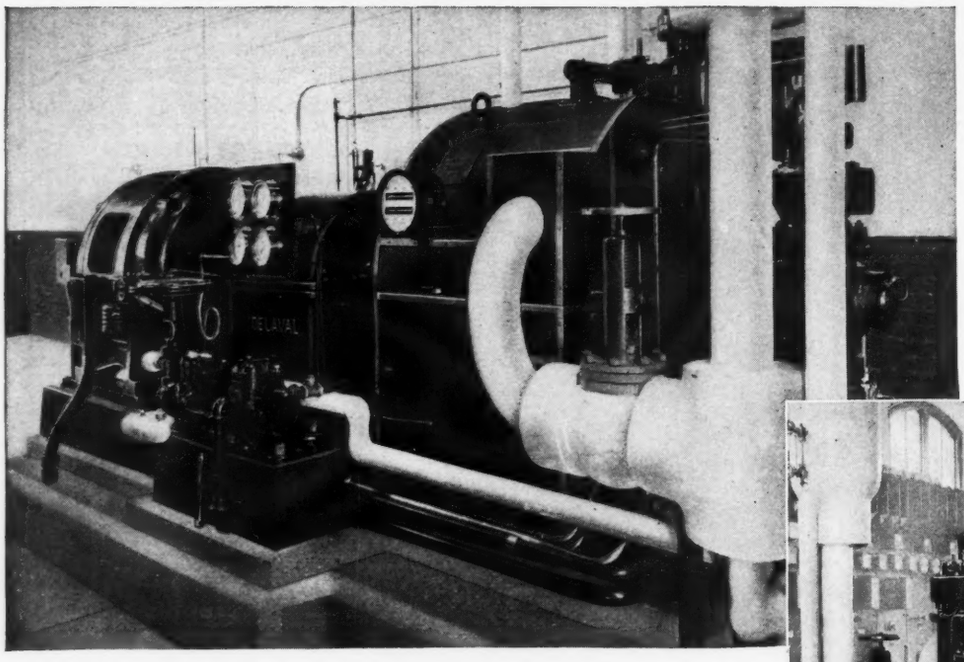


PITTSBURGH PIPING & EQUIPMENT CO.

10 FORTY-THIRD ST., PITTSBURGH, PA.

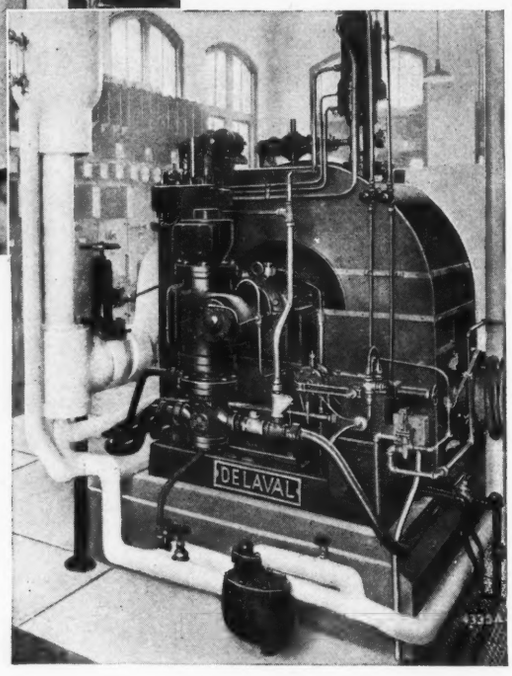
Branch Offices and Representatives in Principal Cities

Pittsburgh Piping



● De Laval geared turbine driving 200 kw. generator.

● Turbine governing devices by which turbine output is controlled in accordance with requirements for heating steam.



BY-PRODUCT POWER *is always Profitable*

TO DECIDE whether or not an industrial plant or building requiring 1000 kw. or less of electric power should generate or buy current requires in some cases close figuring of labor and fixed costs, but there is rarely any question about the savings that can be made by developing power from steam used at reduced pressure for heating and process purposes.

The Foxboro (Mass.) State Hospital ordinarily passes all steam required for heating through the **DE LAVAL BACK PRESSURE TURBINE** shown in the photograph. The admission of steam to the turbine is controlled by a back pressure governor, live steam being by-passed through a pressure reducing valve when the demand for current is very small, while, on the other hand, a small amount of street current is used to supplement the geared turbine driven generator as required.

Engineers of industrial plants and buildings should ask for our Leaflet E-1169, which describes numerous installations in which handsome profits have been realized by replacing or supplementing obsolete equipment with De Laval superposed, back pressure, bleeder or mixed flow turbines.

3512

DE LAVAL *Steam Turbine Co.*
TRENTON, N.J.

MANUFACTURERS OF STEAM TURBINES, PUMPS - CENTRIFUGAL PROPELLER, ROTARY DISPLACEMENT CENTRIFUGAL BLOWERS AND COMPRESSORS, WORM GEARS, HELICAL GEARS, HYDRAULIC TURBINES AND FLEXIBLE COUPLINGS • • • SOLE LICENSEE OF THE BAUER WACH EXHAUST TURBINE SYSTEM